May 2020 Updated LWTB BCA

Description of Changes

This Benefit-Cost Analysis (BCA) of the State's Rebuild by Design (RBD) Living With The Bay (LWTB) project was prepared by the State's consultants WSP in May 2020 in accordance with HUD Guidance on BCAs for RBD projects in CPD-16-06. This BCA updates the State's April 2017 BCA for the LWTB project available HERE to reflect the scope, benefits, costs, projects and other details of LWTB included in the State's Action Plan Amendment 26. HUD required recipients of RBD funding to provide an examination of the funded RBD projects through a BCA in subsequent RBD Action Plan Amendments in the October 16th 2014 Federal Register Notice (FR–5696–N–11).

The major changes included in this updated BCA for LWTB include removal of quantitative analysis of the Coastal Marsh Restoration and the qualitative analysis of stormwater management projects; addition of quantitative analyses of the Lister Park, Educational Programs, East and West Boulevards, and Long Beach Wastewater Consolidation projects; and updates to scope, costs, benefit calculations, benefit-cost ratios and other information for the projects to reflect the projects described in Action Plan Amendment 26.

As projects are added and removed, and project designs and permitting processes have advanced, expected total project costs have increased from approximately $117 million to $147 million; expected total benefits have decreased from around $402 million to around $359 million; and the overall benefit cost ratio has decreased from 3.44 to 2.4.

Changes in each section include:

- **Executive Summary:** updates to number and list of projects evaluated and benefit summary table
- **Introduction:** updates to list of projects
- **Processes for Preparing the BCA:** update information on preparer of BCA
- **Proposed Funded Project:** update to list of projects, budget calculation assumptions
- **Full Project Cost:** updates to project costs
- **Current Situation and Problem to be Solved:** addition of information on project area demographic profile
- **Risks Facing Project Area Community:** addition of information on continued risks without the LWTB project
- **Costs and Benefits by Project Element:** updates to project scopes, budgets and benefits; inclusion of Greenway elements from other LWTB projects in the Greenway benefit-cost analysis and removal from those projects' analysis; recalculation of benefit-cost ratio and other information as required
- **Project Risks:** updates to sensitivity analysis calculation
- **Conclusion:** updates to project list and benefit values
- **References:** updates to references used

Rebuild by Design
Living with the Bay Project

Updated Benefit Cost Analysis
APA Full Narrative

May 2020

Prepared for the New York State Governor's Office of Storm Recovery

(A WSP Company)

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ACRONYMS AND ABBREVIATIONS

BCA	Benefit Cost Analysis
BCR	Benefit Cost Ratio
BMP	Best Management Practice
EA	Environmental Assessment
EPA	US Environmental Protection Agency
ERHS	East Rockaway High School Project
FEMA	Federal Emergency Management Agency
GOSR	(New York State) Governor's Office of Storm Recovery
HLSP	Hempstead Lake State Park
Hofstra	Hofstra University
HUD	US Department of Housing and Urban Development
IRR	Internal Rate of Return
LMO	Low-to-Moderate
LWTB	Living with the Bay
MGD	Million Gallons Per Day
NRPA	National Recreation and Park Association
O&M	Operation and Maintenance
OMB	Office of Management and Budget
NYS Parks	New York State Department of Parks Recreation and Historic Preservation
RBD	Rebuild by Design
SAV	Submerged Aquatic Vegetation
Seatuck	Environmental Association
STP	Sewage Treatment Plan
WPCP	Water Pollution Control Plant

EXECUTIVE SUMMARY

This benefit cost analysis (BCA) was prepared for the Rebuild by Design (RBD) Living with the Bay (LWTB) project area on behalf of the New York State Governor's Office of Storm Recovery (GOSR). The project area is located in Nassau County, New York, and would benefit communities generally located within the Mill River Watershed. The BCA was prepared following *US Department of Housing and Urban Development (HUD) Benefit Cost Analysis (BCA) Guidance for Action Plan Amendments (APA) for RBD Projects* (HUD CPD-16-06). The analysis used generally accepted economic and financial principles for BCA as articulated in Office of Management and Budget (OMB) Circular A-94.

LWTB Project Objectives: The objectives of the LWTB Project are to increase community resilience by mitigating local risk from tidal and stormwater flooding, while incorporating co-benefits such as improved water quality, ecological restoration and recovery, and aquifer recharge. In addition, the project helps to address regional needs for southern Nassau County as defined through the RBD process, including (I) protection from tidal inundation, including future storm conditions with sea-level rise; (ii) better management of river water and stormwater; (iii) improved water quality and riparian restoration; (iv) ecological restoration of coastal marshes and for flora and fauna; (v) provision of enhanced public access and greenway interconnection along the Mill River; and (vi) provision of education and capacity building for environmental stewardship and climate change adaptation resilience.

The objectives can be summarized in the following goal categories:

- Manage Flooding: Reduce inundations from storm surge, stormwater, and tidal flooding
- Strengthen the Ecosystem: Improve the quality of the surface water, groundwater, and the natural environment
- Increase Access along the Mill River Waterfront and Improve Quality of Life: Develop a "Greenway" linking communities through a multiuse path along the Mill River, from Hempstead Lake State Park (HLSP) to Bay Park, thereby creating access to educational and recreational activities, opportunities, and infrastructure, and improving the quality of park assets and environmental and recreational amenities
- Create Local Adaptation and Social Resiliency: Develop education initiatives, public awareness campaigns, and a "restoration economy" project

Project Interventions to Meet LWTB Objectives: The project includes several interventions, which are divided into eight projects. The BCA evaluates the following project interventions within the LWTB Project that address the goals and objectives of the LWTB Resiliency Strategy:

- HLSP
- Smith Pond
- East Rockaway High School (ERHS)
- Lister Park
- Long Beach Water Pollution Control Plant (WPCP) Consolidation
- Greenway Project
- East and West Boulevards Project
- Educational Programs

BCA Economic Feasibility Results: The BCA demonstrates that the LWTB Project would generate substantial net benefits (i.e., the benefits would exceed the costs of the project over its useful life). The benefits to the host community and region would be substantial and justify the costs of implementation and operations. The assets (i.e., physical improvements to HLSP, ERHS, Smith Pond, East West Boulevards, Long Beach, Lister Park and the greenway) created or improved by the project enhancements would create resiliency values, social values, environmental values, and economic revitalization benefits to communities within the Mill River Watershed and to other beneficiaries from Nassau County and the region. Costs and benefits were monetized for each project.

Table ES1 shows the monetized costs and benefits for each project individually, and for the combined eight monetized projects. The largest group of benefits consists of resiliency values related to flood risk protection provided by the projects' assets. In summary, the combined lifecycle costs to build and operate the proposed projects' assets for the LWTB Project (amounting to **$147.1 million** in constant 2018 present value dollars) would generate **$358.6 million** in total benefits during the 50-year analysis period. Benefits would include:

- Resiliency Values: $155.7 million
- Environmental Values: $47.1 million
- Social Values: $34.3 million
- Economic Revitalization Benefits: $121.5 million

Table ES-1: Benefit Cost Analysis Summary-RBD Living with the Bay

	HSLP	ERHS	Smith Pond	Green-way	Lister Park	Education	EW Blvds	LBWPCP	Total
LIFECYCLE COSTS									
Project Investment Costs	$33.3	$1.9	$8.2	$10.0	$2.2	$0.0	$3.5	$77.2	$137.3
Operations & Maintenance	$3.4	$0.8	$0.8	$3.3	$0.9	$1.0	$0.3	$0.3	$9.8
Total Costs	$37.0	$2.7	$9.0	$13.3	$3.0	$1.0	$3.8	$77.5	$147.1
BENEFITS									
Resiliency Values	$0.0	$1.0	$33.6	$2.6	$0.3	$0.0	$5.8	$112.5	$155.7
Environmental Values	$7.7	$2.3	$0.1	$31.0	$3.2	$1.3	$1.2	$0.0	$47.1
Social Values	$15.6	$0.0	$0.2	$18.5	$0.0	$0.0	$0.0	$0.0	$34.3
Economic Revitalization Benefits	$78.7	$0.0	$4.6	$38.2	$0.0	$0.0	$0.0	$0.0	$121.5
Total Benefits	$102.1	$3.4	$38.5	$90.3	$3.6	$1.3	$7.0	$112.5	$358.6

	HSLP	ERHS	Smith Pond	Green-way	Lister Park	Education	EW Blvds	LBWPCP	Total
BENEFITS LESS COSTS									
Net Benefits	$65.4	$0.7	$29.4	$77.0	$0.5	$0.3	$3.2	$35.0	$211.5
Benefit Cost Ratio (BCR)	2.8	1.3	4.2	6.8	1.2	1.3	1.8	1.5	2.4
RBD Rate of Return	92.3%	9.7%	40.0%	165%	8.9%	9.2%	13.6%	10.2%	33.2%

Figure ES-1 shows the breakdown in total benefits for the combined five project elements that were monetized.

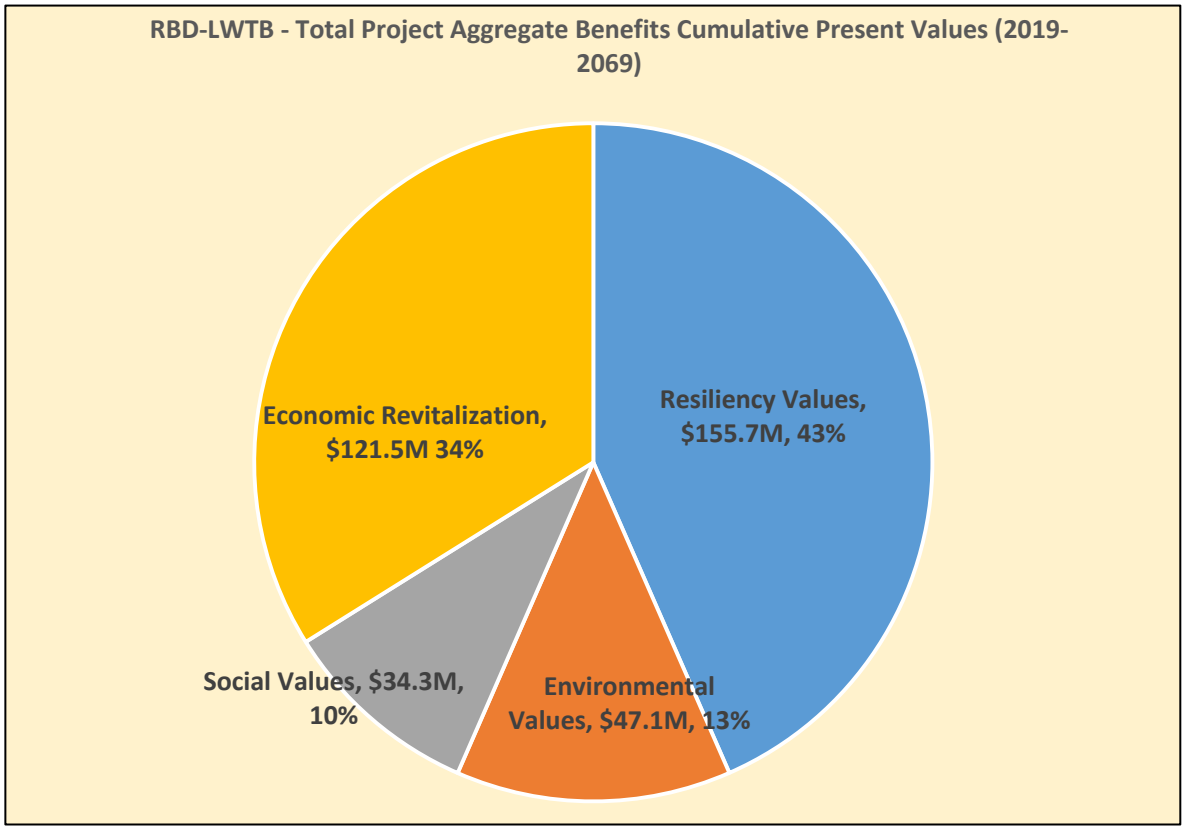
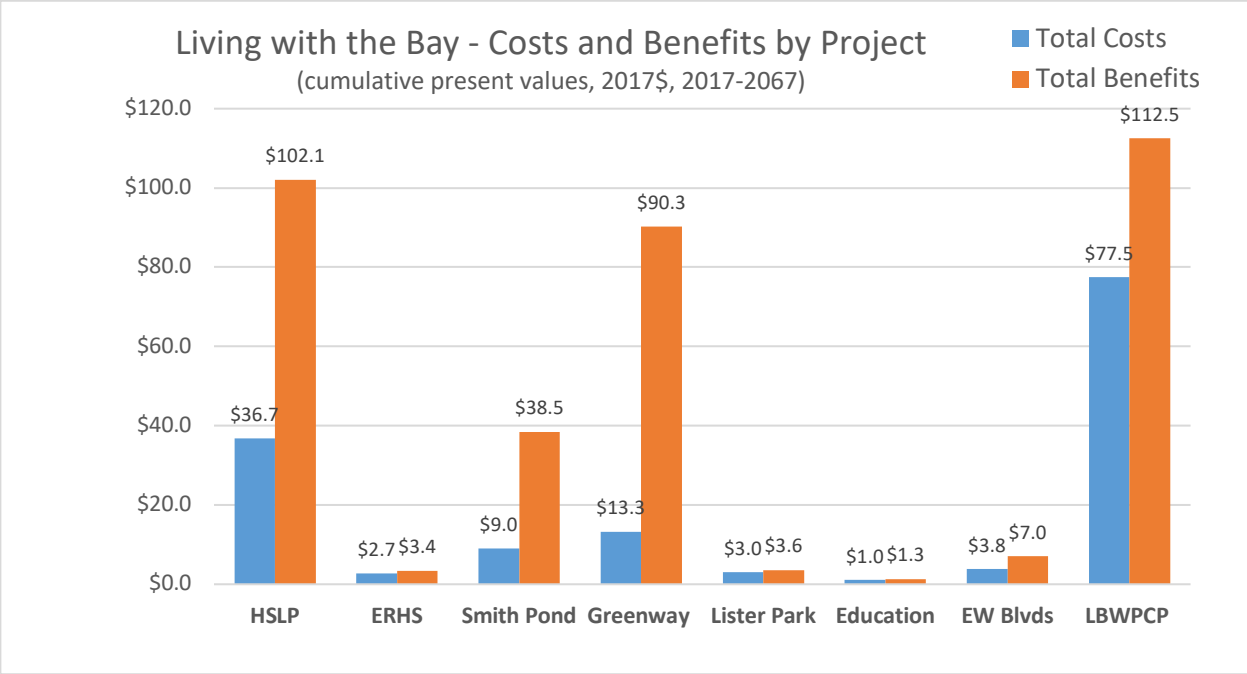


Figure ES-1: Total Project Benefits (2019–2069)

The measures of the LWTB project merit are as follows:

- The Living with the Bay Projects are economically feasible and have a combined positive benefit cost ratio (BCR) of 2.4. Benefits are valued at more than two times the cumulative present value of lifecycle costs.
- The combined cumulative net present value (benefits less costs) of the eight projects is $211 million. A project with a positive net present value is considered an economically viable public project that will add value to the community.

- For a project to be economically feasible, the internal rate of return (IRR) must exceed the discount rate. The combined rate of return of 33% of the eight projects exceeds the HUD recommended project discount rate of 7.0%.
- A critical piece of the LWTB program is addressing flood mitigation. For the program area, this includes finding solutions to chronic drainage problems in the community that continue to worsen as a result of more frequent critical storm events and tidal surges. The approach to address this problem is through a variety of retrofits that incorporate stormwater best management practices (BMPs). The LWTB design identified the desirability of green infrastructure retrofit projects which will improve stormwater collection and conveyance to mitigate flooding and incorporate water quality improvement components.
- Projects implemented as part of the LWTB Project would result in a mix of resiliency, environmental, social, and/or economic revitalization benefits. To the extent practicable, all benefits have been quantified. However, some benefits for these proposed projects are not transferable to a monetized value. In these cases, a qualitative assessment of benefits is presented, per HUD's qualitative rating criteria.



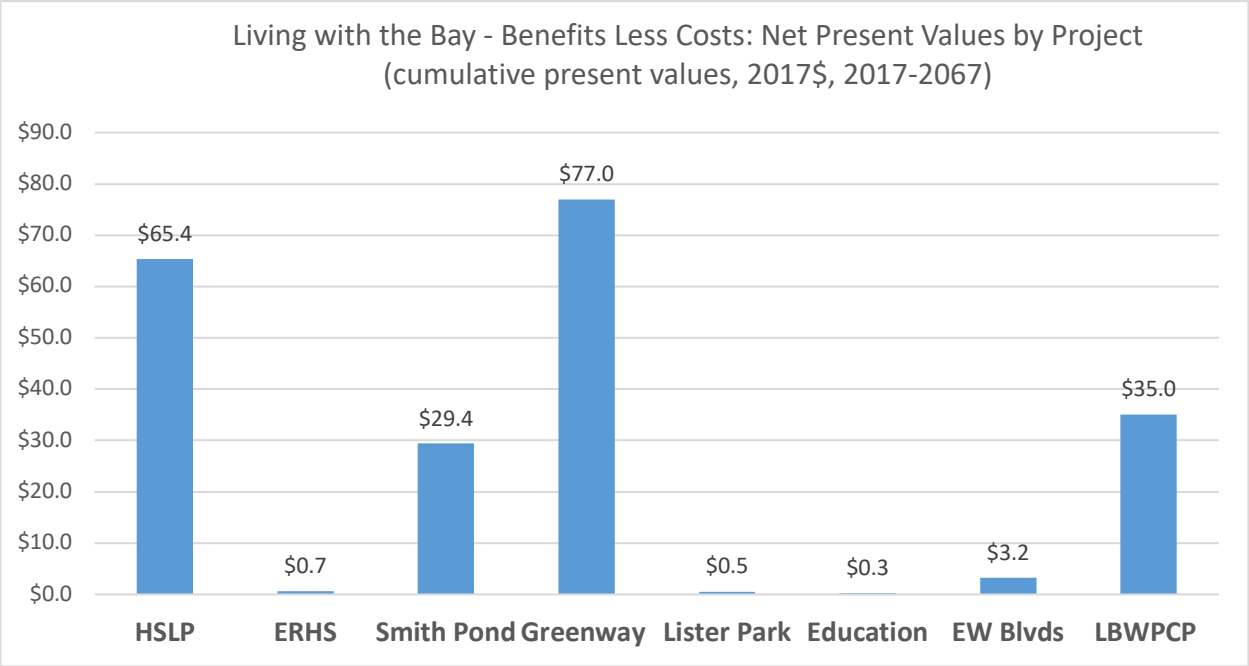


Figure ES-2: Living with the Bay Costs and Benefits by Project

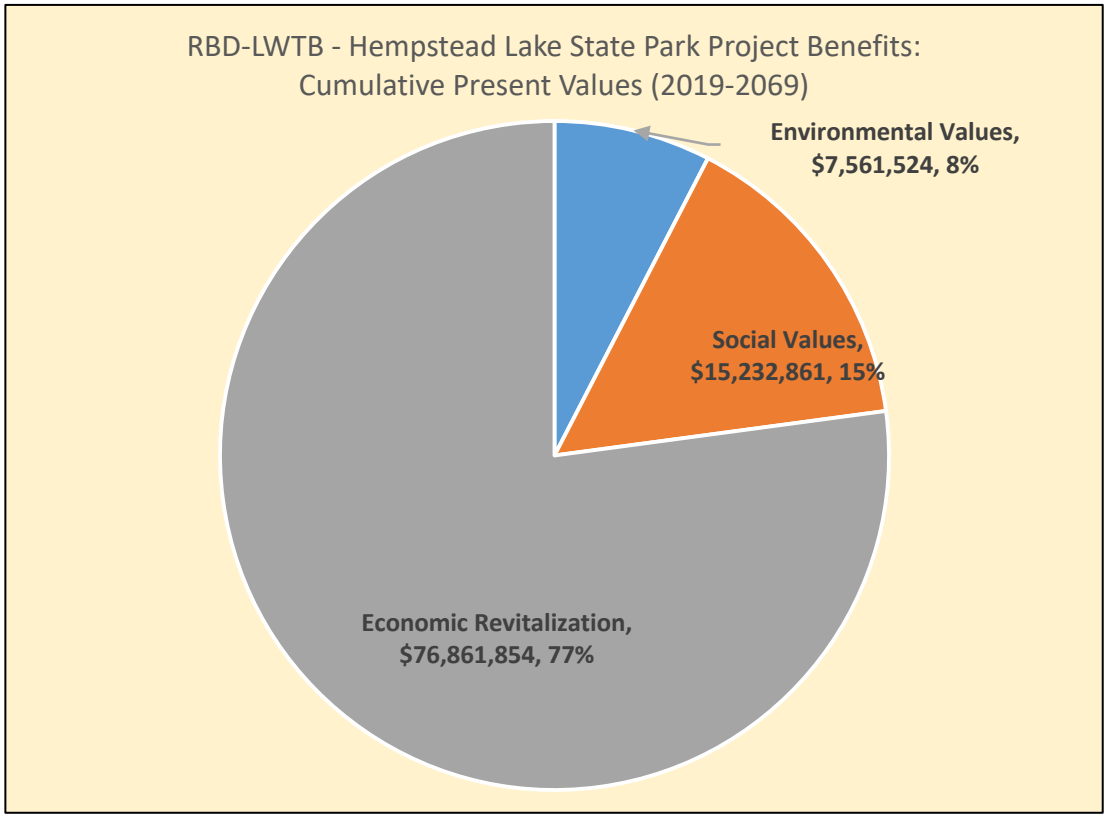


Figure ES-3a: Hempstead Lake State Park Project Benefits

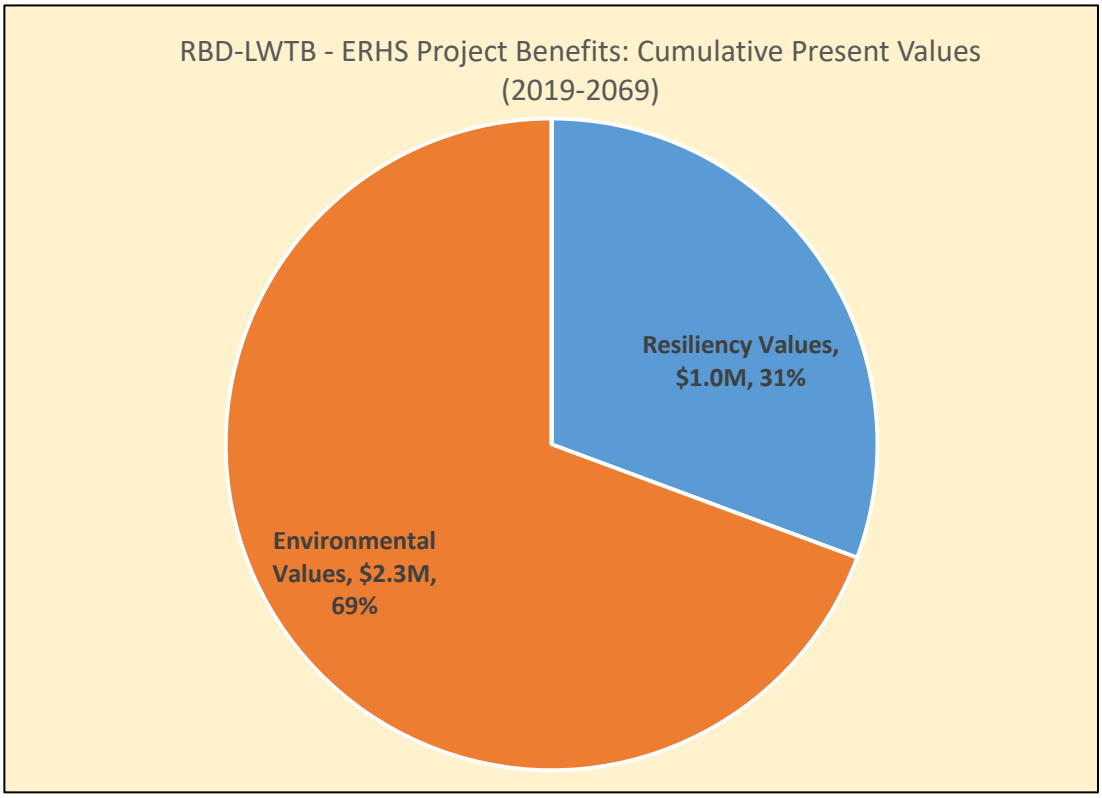


Figure ES-3b: East Rockaway High School Project Benefits

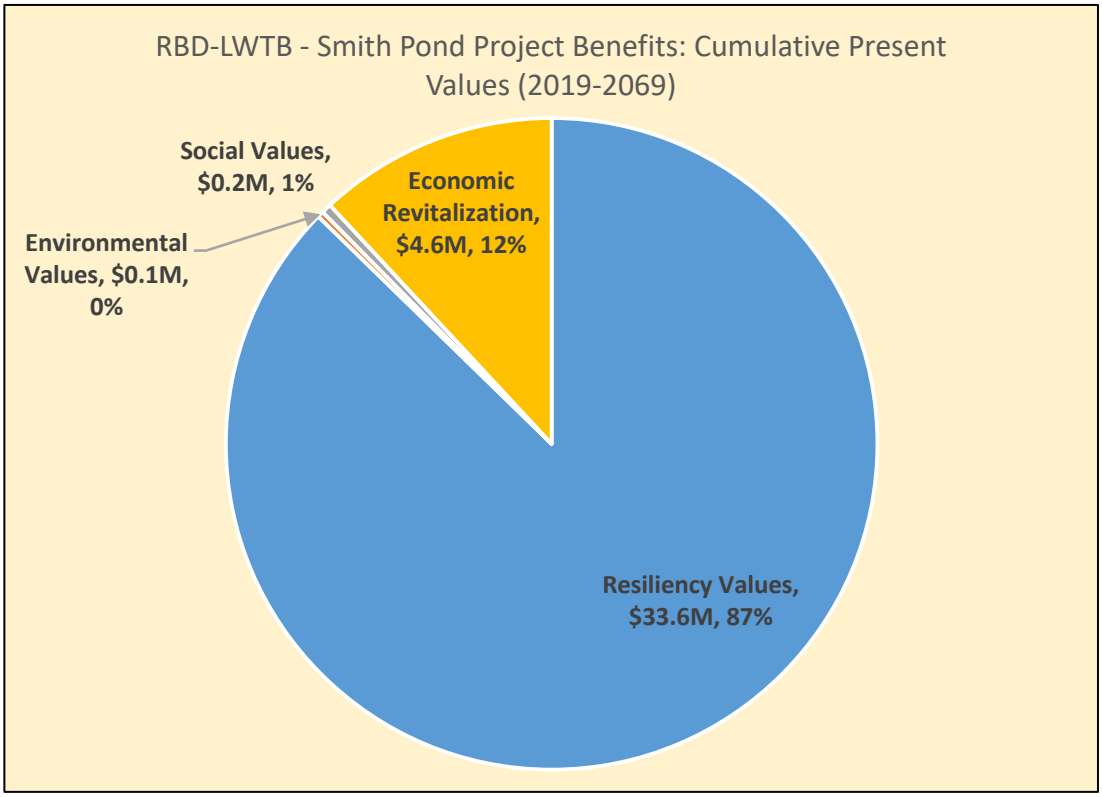


Figure ES-3c: Smith Pond Project Benefits

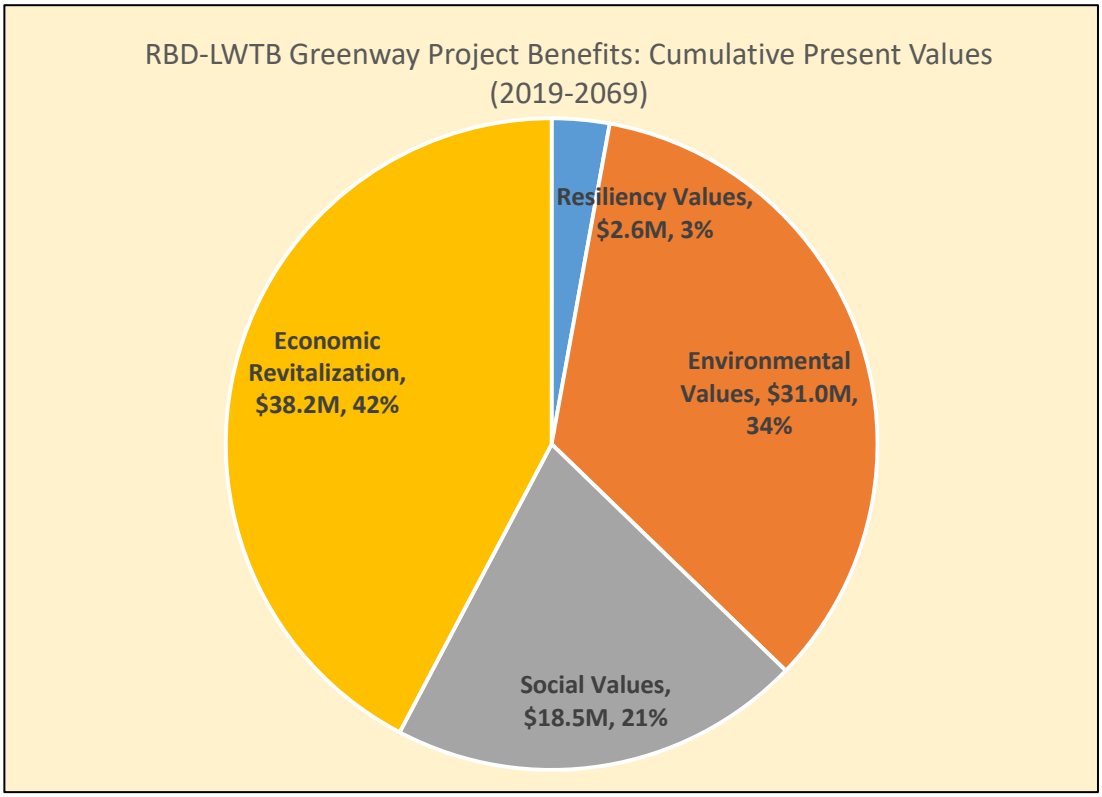


Figure ES-3d: Greenway Project Benefits

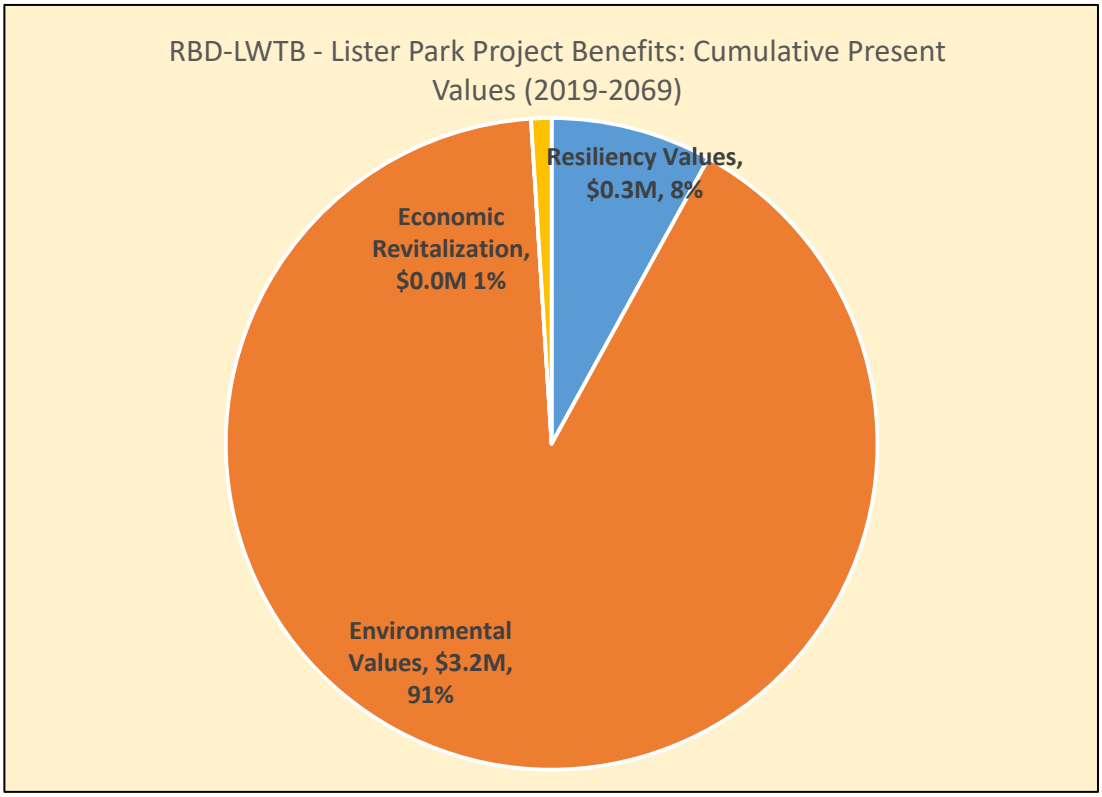


Figure ES-3e: Lister Park Project Benefits

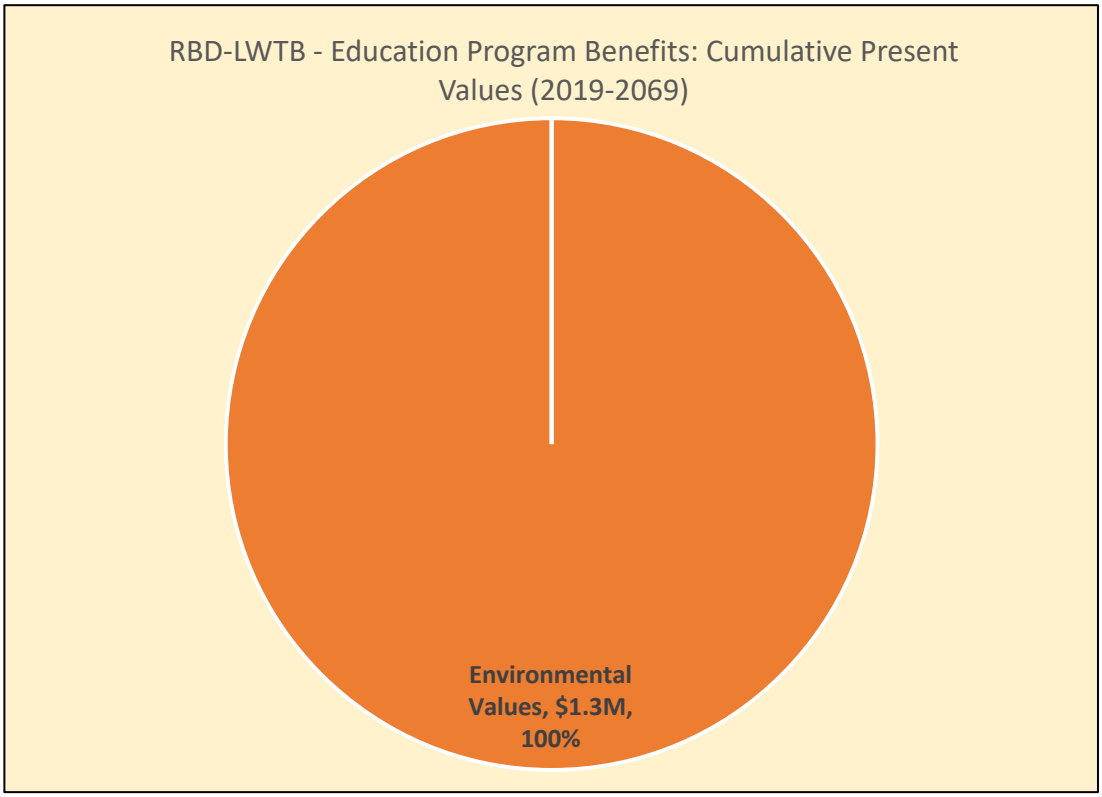


Figure ES-3f: Education Programs Project Benefits

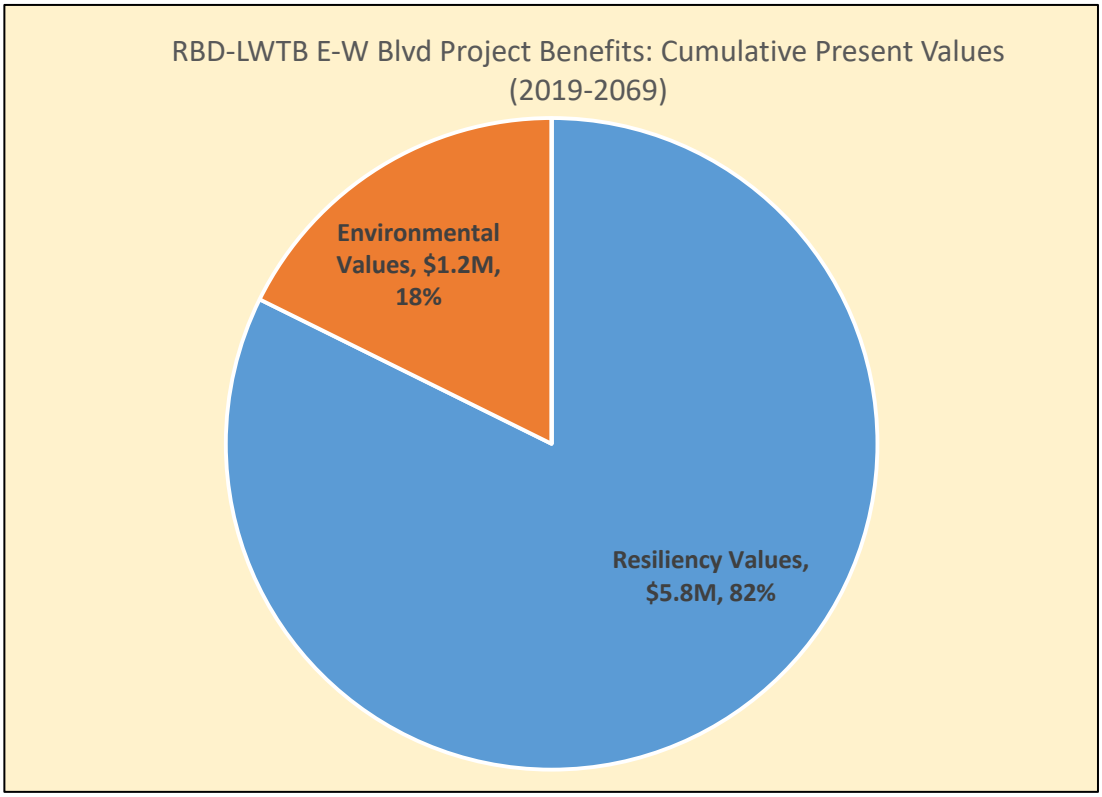


Figure ES-3g: East West Boulevards Project Benefits

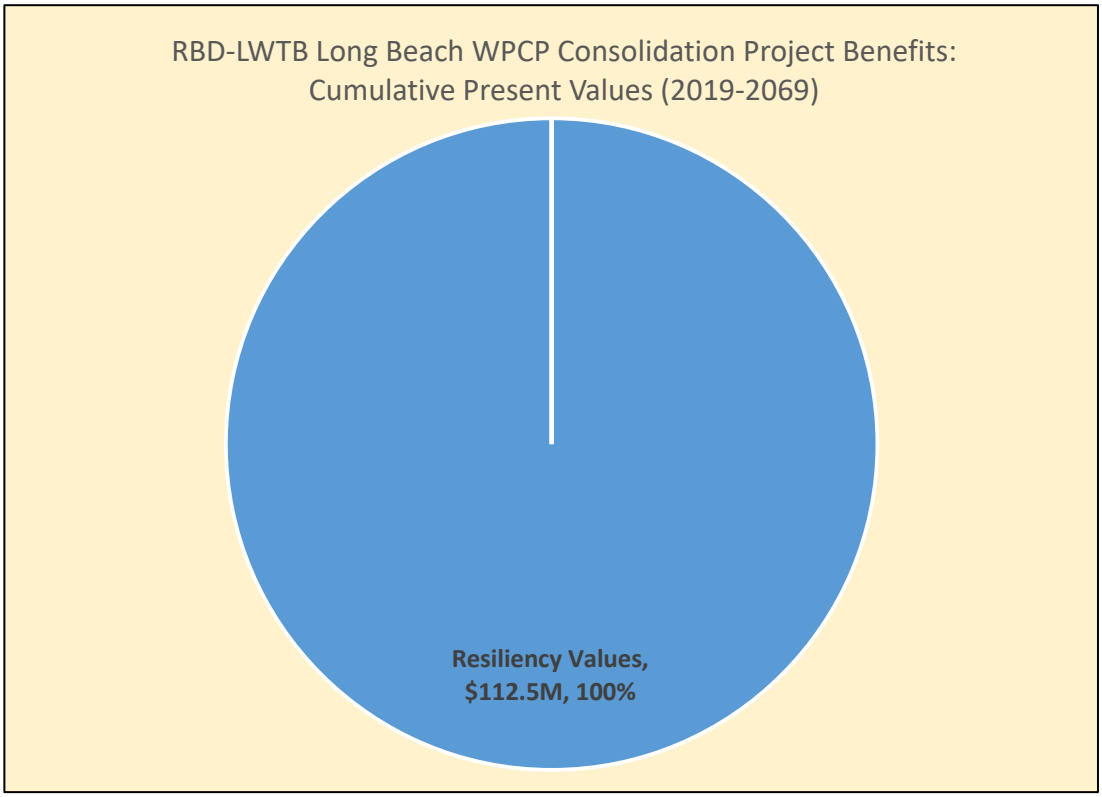


Figure ES-3h: Long Beach Water Pollution Control Plant Project Benefits

1.0 INTRODUCTION

The Rebuild by Design (RBD) Living with the Bay (LWTB) Project Benefit Cost Analysis (BCA) was completed by applying procedures described in the US Department of Housing and Urban Development (HUD) Guidance document CPD-16-06 for RBD projects. The analysis is also consistent with procedures and principles found in OMB Circular A-94. The analysis follows the "with without" project evaluation framework that is used to isolate the net benefits of the intervention.

This BCA evaluates the main project elements or interventions that will be necessary to implement the LWTB Resiliency Strategy's goals and objectives. **Figure 1** provides an overview of the project area for background context.

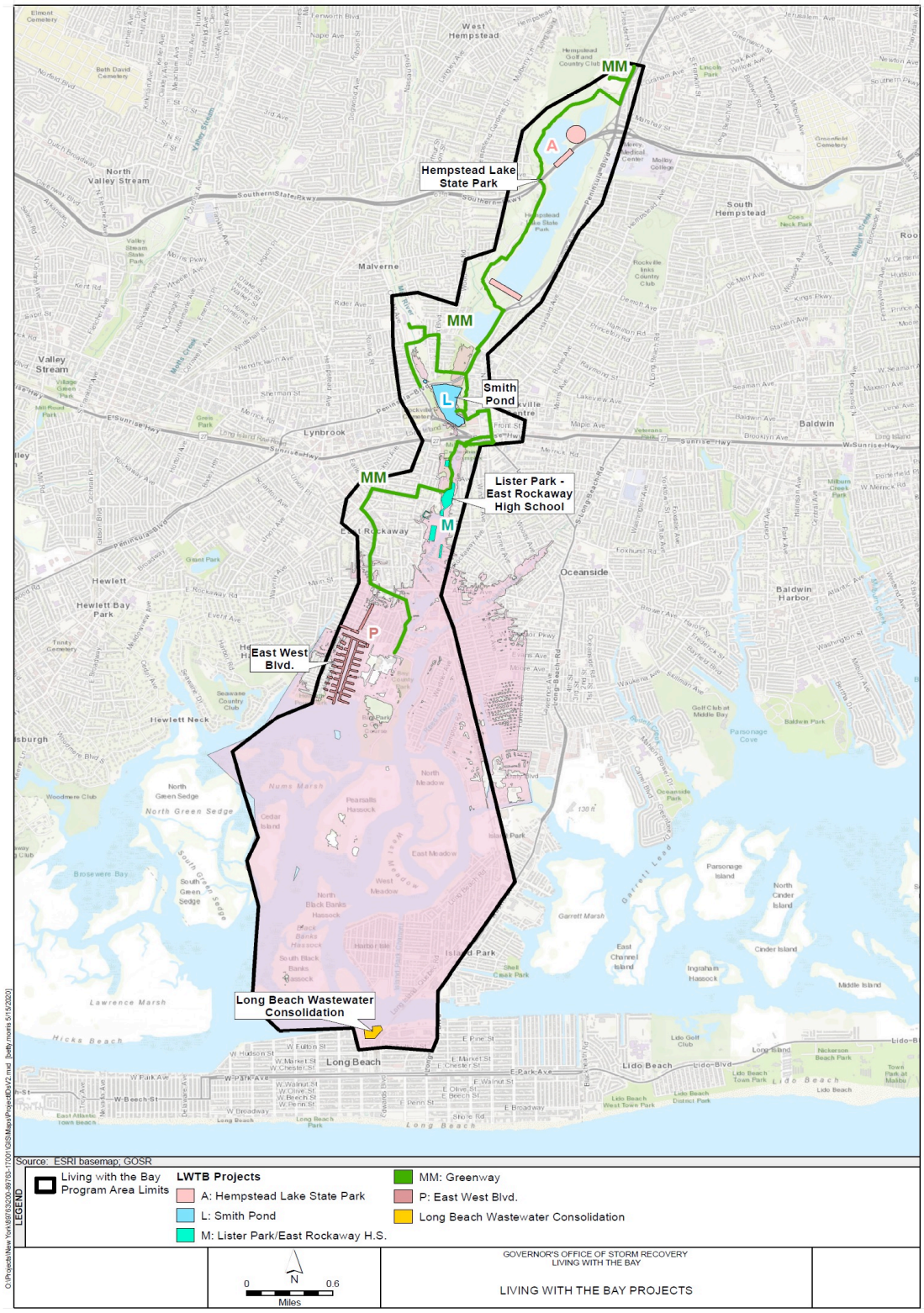


Figure 1: Living with the Bay Project Area

LWTB provides a comprehensive suite of resiliency interventions for Nassau County communities surrounding the Mill River, which is an environmentally degraded north-south tributary flowing from HLSP into the South Shore of Long Island's Back Bay.

The Resiliency Strategy includes coordinated projects focusing on improved drainage collection and conveyance, tidal and storm surge prevention, water quality improvements, habitat restoration, improved public pathways/greenway leading to the waterfront, and public education components. These projects incorporate projected sea level rise into their design (Tetra Tech, 2017).

The interventions evaluated in this BCA include the following projects that are described in more detail below:

- HLSP
- Smith Pond
- East Rockaway High School (ERHS)
- Lister Park
- Long Beach Water Pollution Control Plant (WPCP) Consolidation
- Greenway Project
- East and West Boulevards Project
- Educational Programs

2.0 PROCESS FOR PREPARING THE BCA

This BCA narrative document was prepared by WSP using inputs provided by the New York State Department of Parks Recreation and Historic Preservation (NYS Parks), the New York State Governor's Office of Storm Recovery (GOSR), and their consultants: Stantec, WSP, Cashin, the Hazen & Sawyer – Arcadis Joint Venture, and Tetra Tech. The BCA incorporates information and inputs from the various contributors to the watershed characterization and assessment and the Environmental Assessments (EAs) currently being completed for the HLSP Project and the Long Beach WPCP Project. WSP provided value-added expertise relevant to the BCA in terms of resilience, landscape design, coastal and environmental engineering, ecology, economic analysis, geographic information systems, stormwater management, project evaluation, engineering economics and socioeconomics. In addition, WSP applied its own research findings, collective multidisciplinary expertise, experience, and professional judgment in completing the BCA on behalf of GOSR.

3.0 PROPOSED FUNDED PROJECT

Based in Nassau County, Long Island, the $125 million LWTB RBD project aims to increase the resiliency of communities along the Mill River project area and around the South Shore Back Bay. The project proposes to mitigate damage from tidal storm surge by strategically deploying protective measures such as installing check valves on outfalls below the high tide mark and retrofitting wastewater infrastructure to prevent the release of untreated effluent-constructed marshes; managing stormwater to mitigate the damages from common rain events; and improving the water quality in the Mill River and the bay. As part of LWTB, green and grey infrastructure improvements will be made along the Mill River project area. LWTB will benefit the Nassau County communities of Town of Hempstead; the hamlets of Oceanside,

Harbor Isle, and Bay Park; the Villages of Rockville Center, East Rockaway, and Island Park; and the City of Long Beach. The project aims to decrease the effects of tidal inundation, increase coastal protection, address stormwater runoff into Mill River, and create publicly accessible greenways that connect the communities of the South Shore.

Through a project prioritization, selection, and conceptual design process, GOSR identified the following eight projects:

- **Hempstead Lake State Park Improvements**: LWTB would address stormwater management by rehabilitating and enhancing an existing 100-plus-year-old dam located at HLSP. As an instrument for flood mitigation, the dam (with an operating gatehouse) would reduce and delay peak flows to downstream water bodies and communities during extreme weather events. This project would have several significant co-benefits, such as reducing the risk posed to downstream communities and rehabilitation of this historic structure. Other improvements at HLSP, including wetland rehabilitation and dam repairs in the Northern Ponds area, would further enhance stormwater flow attenuation, improve water quality in the watershed by removing contaminants in urban run-off, and provide enhanced habitat and new, expanded passive recreational opportunities. The HLSP improvements would also include a new facility to be used for education and as a coordination center during emergencies, as well as improved waterfront access at various locations, further improving recreational opportunities in this critical state park.
- **Smith Pond Drainage Improvements**: LWTB would improve water quality, enhance recreation, restore the ecological system to promote native aquatic species, and expand the hydraulic surge capacity of the pond. Project elements anticipated include the removal of invasive species and replacement with native plants on the shores of the pond, improvements to existing pathways and overlooks, connection to the Mill River Greenway, adding a fish ladder, adding floodwalls to the eastern and western shores of the pond, and making improvements to the existing weir. Stormwater improvements to an adjacent parking lot also would be evaluated.
- **East Rockaway High School Hardening**: LWTB would install a bulkhead to reduce erosion, protect against storm surge, and facilitate the raising of the athletic fields to provide better stormwater management. Drainage improvements would be added to the parking areas for better stormwater management and improved water quality. The project also would consider opportunities for stormwater storage backflow prevention devices, and a generator to support the school as an emergency shelter during disasters.
- **Stormwater Retrofits**: The State of New York would strategically install green infrastructure including, but not limited to, drywells, bioswales, permeable pavement, and select bioretention and infiltration interventions throughout the project area. Improvements along East and West Boulevards would mitigate the effects of tidal and stormwater inundation by deploying check valves, bioswales, and permeable pavement, while stormwater best management practices such as bioswales and surface infiltration systems would be included in other focus areas to retain, treat, and delay stormwater before it enters the Mill River.
- **Lister Park:** LWTB would implement a suite of resiliency, water quality, and drainage improvements to an area along the Mill River composed of the existing Village of Rockville Centre's Department of Public Works storage yard and several public parks known as Bligh Field, Centennial Field, Lister Park, and Tighe Field. The improvements would include a living shoreline to combat erosion and filter urban and stormwater runoff entering the Mill River, bioretention

basins and drainage improvements to improve stormwater management and treatment, flood protection improvements to protect surrounding residential areas, greenway connections, and an improved overlook to connect residents to the Mill River.

- **Greenway Network:** LWTB would create greenways connecting communities with sections of the project area and focus areas along the Mill River, including north from HLSP, through HLSP, south to Smith Pond and Lister Park, and connecting the greenway farther south to Nassau County Bay Park.
- **Long Beach Water Pollution Control Plant Consolidation Project**: LWTB would convert the existing WPCP at Long Beach into a resilient pump station that would send untreated effluent to the newly upgraded Bay Park Sewer Treatment Plant (STP). Tidal inundation from Hurricane Sandy overwhelmed the Long Beach plant and interrupted treatment, resulting in the release of untreated effluent into South Bay. Damage from Sandy caused legacy operational issues that affect the quality of treatment that the WPCP provides, resulting in the continued release of undertreated effluent with high levels of nitrogen that negatively affect tidal marshes and water quality throughout South Bay and the communities in the Mill River Watershed such as Bay Park, Oceanside, and East Rockaway, which are impacted by the Bay's tides and storm surge. The project would preserve quality of life during increasingly frequent storm events and increase community resiliency in the face of sea level rise by mitigating the hazard of storm impacts that cause the release of untreated effluent to the Bay. The project also would incorporate environmental, coastal resiliency, and water quality benefits for the LWTB project area by ensuring a higher standard of treatment of effluent at the Bay Park STP.
- **Education Programs**: LWTB has worked with relevant community organizations and educational institutions to develop public education programs. These education programs would include environmental and historical education for schools and the public. The programs also would include a certificate program for local government policy makers and staff on environmental sustainability, which would contribute to a culture of focusing on the environment in local decision-making. LWTB also would develop job training programs with a focus on green infrastructure to contribute to the social resiliency of communities along the Mill River and South Bay.

The LWTB Project contemplates a capital budget of $154 million (in 2018 constant dollars) to be applied to the above project elements. For BCA analysis purposes, construction is generally assumed to start in 2020 and be completed by the end of 2021, except where otherwise noted. Project operations (and the generation of benefits) would therefore start in 2022.

Project construction is anticipated to start in 2020 and last 24 months. For the purposes of this BCA, the capital construction costs (Project Investment Costs) are phased in ratably over this time period. The BCA also assumes a 50-year project evaluation time horizon. A discount rate of 7 percent, recommended by HUD and per OMB Guidelines, is applied. As such, in the tables, the net present value (NPV) of projects is presented. For capital costs, this NPV of construction costs spread across years is inherently less than the total construction cost.

4.0 FULL PROJECT COST

Table 1 shows the estimated capital costs for the eight project elements within the BCA.

Table 1: Summary of Capital Cost Estimates for Living with the Bay by Project Element

	Capital Cost (in $millions)
Hempstead Lake State Park	$35.98
East Rockaway High School	$2.14
Smith Pond	$9.08
Greenway Project	$11.04
Lister Park	$2.39
Education Programs	$1.14
EW Blvd	$3.84
LBWPCP	$88.2
Total	**$153.81**

Table 1 shows estimated capital construction costs for each project element based on the best available information as of August 2019.

5.0 CURRENT SITUATION AND PROBLEM TO BE SOLVED

During Hurricane Sandy, Nassau County was hit with heavy rain and an 18-foot tidal surge. Fourteen people lost their lives, and approximately 113,197 homes were destroyed. Public and private infrastructure along the Mill River was damaged, including bridges, businesses, parks, roads, schools, and a wastewater treatment facility at the entrance of the Bay. Over the last century, the Mill River Watershed has become more populated with communities growing along each bank. Increasing populations and continued development have made the Mill River communities more susceptible to flooding from storm surge and rain events. Along the Mill River, low-density suburban development has degraded natural buffers that once offered protection to neighborhoods and ecosystems alike. Without robust vegetated buffers along the river to absorb and store rainwater and coastal inundation, stormwater drained rapidly into the Mill River, backing up outflow pipes and causing severe inland flooding. Tidal surge also impacted the Long Beach WPCP, sending not just untreated stormwater, but also untreated sewage, into the surrounding area.

Socioeconomic conditions in the Mill River Watershed vary, depending on the specific location within Nassau County, the Town of Hempstead, or Long Beach. For example, the area near the ERHS/Lister Park Project is populated with 40 to 60 percent low-to-moderate income households, and the area near Smith Pond is populated with 60 to 80 percent low-to-moderate income households (Tetra Tech, 2017). A US Environmental Protection Agency (EPA) environmental justice analysis (EJSCreen) is provided in **Appendix A**. The analysis shows that the watershed is at or above the 50th percentile in the state, EPA region, and nationally for a number of demographic indicators, including minority population, linguistic isolation, residents with less than high school education, and residents older than age 64. For environmental factors, the watershed is above the 50th percentile for state, EPA region, and nationally

for particulate matter, ozone, diesel particulate matter, air toxics cancer risk, respiratory hazards, and traffic volume.

The Resiliency Strategy includes coordinated projects focused on addressing the problems with the anticipated sea level rise impacts accounted for in the analysis. This includes improved drainage collection and conveyance, tidal and storm surge prevention, water quality improvements, habitat restoration, improved public pathways to the waterfront, and public education components. The Resiliency Strategy strategically prioritizes projects with program-specific timeframes and costs for planning, design, permitting, procurement, construction, and project closeout (Tetra Tech, 2017).

6.0 RISKS FACING PROJECT AREA COMMUNITY

The Mill River Watershed community faces risk associated with flooding due to storm surge and tidal inundation (within the southern catchment portion of watershed) and also frequent and extreme high velocity stormwater events that disrupt the quality of life and economy of the community throughout the watershed. In the southern catchment portion, there are risks associated with ongoing coastal habitat degradation, erosion and loss of marsh wetlands, and attendant water quality problems. In addition, there is a desire to improve the public's access to the waterfront and provide a contiguous enhanced greenway linking the Mill River's surface water bodies.

Ecosystem services in the Mill River Watershed have been degraded by decades of suburban development, associated with a measurable increase in impervious surfaces and stormwater runoff. Stormwater runoff over impervious surfaces causes increases in non-point source pollution. The runoff carries pollutants that ultimately deposit into the nearby water bodies, such as Hempstead Lake, South Pond, Smith Pond, and the Mill River itself. Pollution and the associated impaired waters of the Mill River travel downstream to the back bays, where the resulting elevated nitrates deteriorate the wetlands.

In addition, there are long-term risks associated with climate change adaptation. While the damage from Hurricane Sandy was caused primarily by storm surge, stormwater flooding poses a significant risk from precipitation events. Both storm surge and stormwater flooding may be exacerbated through the impacts of climate change. Localized stormwater flooding, which occurs approximately twice a month on spring tide and moon tides, is expected to increase as a result of anticipated increases in general sea level and frequency of extreme events such as high wind induced surges.

These risks would continue into the future (i.e., 5, 20, and 50 years) if the LWTB Project were not implemented. These risks would increase with climate change and sea level rise. Risks to low-to-moderate income populations or populations exposed to other adverse environmental factors would continue.

The Resiliency Strategy and project interventions will mitigate community risks and educate the public on stormwater and environmental management and climate change resilience issues (Tetra Tech, 2017).

7.0 COSTS AND BENEFITS BY PROJECT ELEMENT

This section describes the anticipated lifecycle costs and benefits by each resource area, for each proposed intervention. The project evaluation horizon extends from 2019 to 2069, a 50-year period per HUD BCA Guidelines (HUD CPD-16-06).

7.1 Hempstead Lake State Park

Project Objectives: Improve and enhance the resilience of Hempstead Lake State Park and its infrastructure as necessitated by the increased development of the watershed since its original establishment as a water reservoir and as exacerbated during major storm events, which are expected to increase in severity and frequency over time. Hempstead Lake State Park falls within the upper portion of the Mill River Watershed and provides key opportunities to improve flood management, enhance the natural ecosystems, provide connectivity between diverse populations, and enhance safety and provide emergency response facilities, all while promoting environmental education and increased usage of the Park (Parks, 2017 a).

Project Description: The Project involves the northernmost portion of the Rebuild by Design: Living with the Bay project and it encompasses several elements in and around Hempstead Lake State Park. Project elements include dams, gatehouses, ponds, bridges, the education and resilience center and greenway waterfront improvements.

- The dams component would make the flow control structures operable and provide a means to manage stormwater, include dam improvements to meet current regulatory standards, and gatehouse renovations.
- The ponds component would involve the installation of floatables catchers and sediment basins at pond inlets, create stormwater filtering wetlands, and improve water quality. It will reestablish flow patterns through the ponds and wetlands that have been impacted by the floatables debris and sediments that have blocked the flow patterns.
- Trails through the new wetland areas and along paths near the sediment basin and floatables collection offer the opportunity to provide additional educational messages about the interrelationship between the runoff from downtown Hempstead and the tidal bays to the south. The project would also involve installation of an improved greenway and trail system throughout the park, as well as new bridge connections to allow pedestrian, and bicyclist access and connectivity.
- Improved emergency response, vehicle access and coordination of incident command.
- West of Lakeside Drive, the project would include construction of a new, two- story, 8,000-square-foot Education and Resilience Center (Parks, 2017 a). The focus of the Education and Resiliency Center would be on environmental stewardship, and climate change adaptation resiliency.

7.1.1 Lifecycle Costs

Lifecycle costs consist of both capital construction costs and the long-term annually recurring operations and maintenance costs that would be required to maintain the Hempstead Lake State Park (the “Park”) assets and improvements delivered by the intervention. **Table 2** shows a breakdown of the main capital costs by project component.

Table 2: Hempstead Lake State Park Project Capital Costs by Main Project Element

Description	Total	Percent of Total
Dam Improvements and Bridge Crossings	$4,312,321	12.0%
North West Pond	$419,758	1.2%
North East Pond	$9,083,143	25.2%
Education and Resilience Center	$3,158,407	8.8%
Greenway / Waterfront Improvements	$9,517,886	26.5%
Estimated Greenway Costs (Analyzed Separately)	-$412,258	-1.2%
Subtotal:	$26,069,188	72.5%
38% Contingency \a	$9,906,291	27.5%
Total	$35,975,480	100.0%

Source: <<LWTB Parks Cost Est. 20160912.pdf>>

Notes:

\a Thirty-eight percent contingency is calculated based on base capital costs in subtotal.

The Hempstead Lake State Park Project (hereafter, "HLSP") is expected to cost approximately $35.98 million. Note that greenway costs that are bundled in other line item estimates have been removed from this portion of the analysis and are analyzed in a separate section in this document. The estimated greenway costs that are subtracted from this estimate were developed by calculating the percentage of greenway linear feet within HLSP and applying that percentage to the total estimated greenway costs. Improvements north of the Southern State Parkway represent about one-third of the project cost and represent the bulk of the project costs. Operational and maintenance costs consist of the elements shown in **Table 3**.

Table 3: Hempstead Lake State Park Project Annual Operational and Maintenance Costs

O&M Element	Annual Cost	Percent of Total
Floatables collection system annual cost	$130,000	46.7%
NW Pond and SSP Collection	$32,000	11.5%
Dam Maintenance	$15,000	5.4%
Filtering wetlands clean-up and maintenance	$10,000	3.6%
Trails/Waterfront Structures/Waterways/Bridges/Greenway Parking/Education and Resiliency Center	$91,200	32.8%
Annual O&M	$278,200	100.0%

Source: Parks, 2017 a, b; NYC Parks, 2019

Note that while a separate BCA has been prepared for greenway elements included in Hempstead Lake, state park officials developed O&M costs that bundle greenway costs with other operations costs (e.g.,

waterfront structures, education and resiliency center). This analysis conservatively includes all those O&M costs. Floatables collection annual costs represent the largest share of annual O&M for HLSP.

7.1.2 Resiliency Value

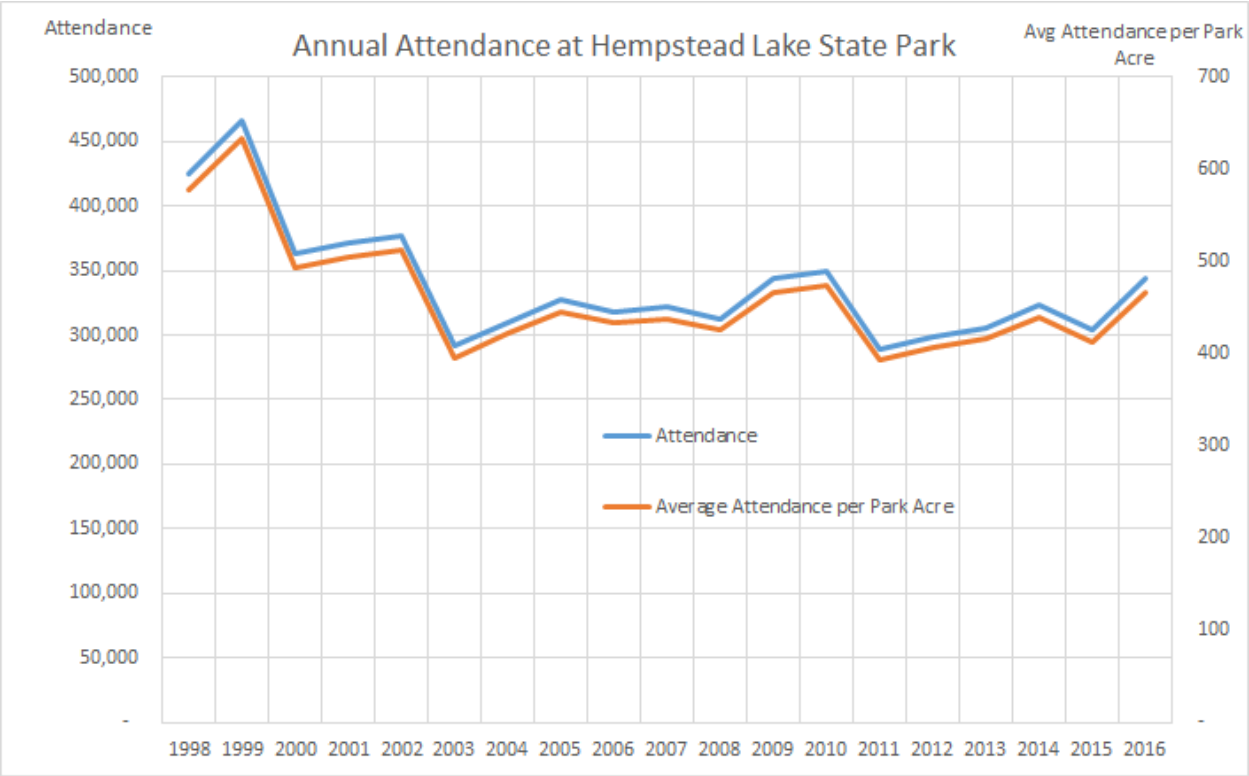
The main resiliency values for the Hempstead Lake State Park Project are associated with the dams' component that would make the flow control structures operable and provide a means to manage stormwaters, and include dam improvements to meet current regulatory standards, and gatehouse renovations. In addition, the ponds component would involve the installation of floatables catchers and sediment basins at pond inlets, create stormwater filtering wetlands, improve water quality, and manage impoundment capacity. HLSP resiliency benefits associated with the dam improvements such as the improved management capabilities within the upstream catchment portion of the watershed are not reflected within the BCR but are acknowledged to be a benefit that would be assigned a + (i.e., expected positive impact) per HUD qualitative rating instructions. Water quality values for HLSP were included from wetlands creation that is included within the *Environmental Value* section of the BCA.

7.1.3 Social Value

Visitation User Value

The HLSP project will facilitate access to park space for users and will also enhance the existing recreational experience for park visitors. Over time, local residents could attend more frequently as knowledge spreads about enhanced park features and park amenities experienced by friends, neighbors and broadcast through word of mouth, public outreach and press/media coverage. **Figure 2** shows the historic annual attendance at HSLP and the average attendance per park acre. The HLSP has 736 acres.

Figure 2: Annual Attendance at Hempstead Lake State Park



The Project will result in approximately 7 additional acres for public access. This additional access does not mean that all 7 acres will be cleared, only that they will be publicly accessible (Stantec, 2017).

Incremental Recreational User Value

Cleanup of debris and solid waste along the shoreline and removal of invasive vegetation in the nearby woodland areas of the pond system, along with installation of a floatable debris catchment system, will enable Hempstead Lake State Park (HLSP) to provide additional novel area for recreational visitors. The Northern Ponds section of the park will be more accessible, with additional trails and passive recreational space in a densely populated area.

The proposed project will entail paving and striping an existing dirt lot to provide 48 formalized, accessible parking spaces to the general public. To estimate the visitation that might be accommodated with this accessible parking, the average annual visitation per space at HLSP's current parking facilities (near Lakeside Drive and Southern State Parkway) was calculated. This value averaged approximately 391 visitors, per year, per parking space. **Table 4** and **Table 5** show the data and assumptions that were applied.

Table 4: Incremental User Value

Element	Value	Unit
HLSP estimated number of existing parking spaces	868	Parking space
Living with the Bay Project formalized, accessible spaces	48	Parking space
Annual Average Visitors Per Existing Parking Space	391	Est. Visits/space
Incremental Annual Attendance	18,747	No. visitors
Recreational Use Value per User Day (see Table 5)	$56.98	$
Annual Incremental Recreational Use Value	$1,068,173	

Source:
Hempstead Lake State Park, 2017

Table 5: Recreation Use Values per Person per Day by Primary Activity-Northeastern Region

Activity	Value/pc/day
General Recreation	$35.37
Wildlife Viewing	$61.24
Hiking	$74.33
Average:	$56.98
Source: RUVD, 2016	

Table 5 shows recreational use values per day by primary activity. These values were obtained from the updated Recreational Use Value Database for North America, applying the Northeastern Region mean values (RUVD, 2016)[1]. An average recreational use value per visitor day was applied reflecting likely uses for visitors to HLSP.

The cumulative present value of the annual value of incremental park visitation was estimated to be $12,810,305 over the 50-year period.

Value of the Education and Resilience Center

West of Lakeside Drive, the project would include construction of a new, single-story Education and Resiliency Center, with an unfinished basement. The approximately 8,000-square-foot (an irregular footprint of approximately 52' x 96') center would include an education room, flexible meeting spaces, a lobby, overlook deck, restrooms, kitchen, and storage facilities. The space would be designed to be

[1] The RUVD (2016 update), maintained by Oregon State University currently contains 421 documents of economic valuation studies that estimated the use value of recreation activities in the U.S. and Canada from 1958 to 2015, totaling 3,192 estimates in per person per activity day units, adjusted to 2016 USD. Twenty-one primary activity types are provided. These recreation use value estimates are measures of net willingness-to-pay or consumer surplus for recreational access to specific sites, or for certain activities at broader geographic scales (e.g., state or province, national) in per person per activity day units.

flexible enough to accommodate a variety of uses, including as a gathering space during a storm event such as Sandy. The Center will provide a connection point for residents to the Hempstead Lake. The proposed Center would be designed to a high LEED standard with a goal toward a net-zero energy solution.

The Education and Resiliency Center would seek to build partnerships with local schools to make use of the education space and wet lab, and it would educate students on the importance of parks and wetlands—particularly during extreme weather. There would also be information about the Mill River Corridor system as a whole, local wildlife and history of the area. Permit applications administered by New York State Parks would be processed from the center.

During an extreme weather event, the proposed addition of this Center would help assist the community by serving as a command center during major storm events. The Center would provide a single point of access for information for residents seeking access to community services. Also, by virtue of maintaining a generator on site, the Center would ensure that residents continued to have access to electricity during a storm event—guaranteeing that the community would have a secure location to charge mobile phones and reach outside resources.

The Center would also include training space for the Nassau County Law Enforcement Explorer Program. This volunteer program provides an opportunity for young adults to receive basic law enforcement training and to learn about career opportunities within law enforcement. In addition to training and education, volunteers participate in community service events throughout the year to encourage volunteerism and build stronger communities.

In order to quantify the benefit the Education and Resiliency Center would provide to the local community, a per-visit utility value was applied. The visitor utility use value was provided by a study conducted by Texas A&M University. The study found that visitors to educational facilities derived a benefit valued at $25.00 (Harnik and Crompton, 2014). This value was applied to the total number of visits per year to the education facility, estimated as equal to one visit every three years by students at one of the six neighboring school districts. The universe of potential school districts who may gravitate to the Center included West Hempstead Union Free School District, Hempstead Union Free School District, Malverne Union Free School District, Rockville Centre Union Free School District, East Rockaway Union Free School District, Oceanside Union Free School District, and two Charter Schools. The annual amount of estimated student visits was 7,618 per year.

Adjusting for inflation in the original educational utility value, the cumulative present value of this benefit was estimated to be equal to **$2,422,556.**

An important component of this project is consideration for the students who would be served by such an educational facility. According to the New York State Education Department, the area is majority-minority and serves a large number of economically disadvantaged students. Within the 41 schools in the project vicinity, including 39 public schools and two charter schools, 60 percent of the students are non-white, 45 percent are economically disadvantaged, and 14 percent of students have limited English proficiency (NYSED, 2015).

Community Cohesion

Parks offer an opportunity for community members to meet, interact, strengthen the community and build social capital. Studies on the value of parks and open space include community cohesion as one of

the benefits of parks (NPRA, 2010; Harnik, 2009). In neighborhood parks, residents of all ages can interact, which improves the quality of life in the neighborhood. Furthermore, the social capital that is created through parks - especially when neighbors work together to create, save or renew a park or open space - not only benefits resident quality of life but wards off anti-social problems, reducing the need for police, prisons, and rehabilitation.

The benefit of community cohesion was not quantified. The magnitude of the benefit will be affected by the level of community involvement during the development of the project as well as by the use of the project area and facilities by residents upon the project's completion.

7.1.4 Environmental Value

The environmental values associated with Hempstead Lake State Park were assessed based on the number of acres that would be created and would add ecosystem service values and improve water quality. The Project proposed to create approximately 20 acres of new wetlands, including filtering wetlands within and to the north of NE Pond to filter flow from Mill Creek and from the Southern State Parkway outfalls, as well as develop riparian wetland edge along the southeastern edge of NW Pond east of the dam to enhance the trail system through that area (Parks 2017 a).[2]

Wetland areas add ecosystem service flows perennially. A benefits transfer approach was applied to value the twenty acres of incremental service flows to the Park based on applying the National annual average benefit values per acre for individual ecosystem services per year produced by wetlands mitigation required under Section 404 of the Clean Water Act (Adusumilli, 2015). **Table 6** shows the tables of values that were applied within the benefits transfer application.

Table 6: National Annual Average Benefit Values Per Acre for Individual Ecosystem Services

Ecosystem Service Value per Acre Applied in Valuation	Annual Average Benefit Value per Acre (2010 $)	Annual Average Benefit Value per Acre (2018$) \a
Recreational Fishing	$2,288	$2,610
Bird Watching	$11,166	$12,739
Water Supply Protection	$5,882	$6,711
Flood Control	$1,442	$1,645
Water Quality Protection	$7,987	$9,112

Notes:
\a Updated to 2018 by applying the US CPI
Source: Adusumilli, 2015

[2] The 20 acres of new wetlands is based on the original project design. As of April 2020, the proposed project is undergoing permitting review by the U.S. Army Corps of Engineers and New York State Department of Conservation. NYC Parks is currently coordinating with the U.S. Army Corps of Engineers regarding a compensatory mitigation proposal. Final acreages, types, and locations of wetland compensatory mitigation will be included in an updated version of this BCA.

Applying the ecosystem service values to the 20 acres resulted in combined annual ecosystem service flows of $23,705 for the combined services of Recreational Fishing, Bird Watching, Water Supply Protection and Flood Control. The Water Supply value was calculated separately using $6,711 per acre. The cumulative present value of the ecosystem service values over the 50-year project evaluation period amounts to **$7,561,524.**

7.1.5 Economic Revitalization

Local parks generate economic activity and support jobs (NRPA, 2020). This BCA specifically quantifies benefits to property values and employment. Upon completion of the project, economic revitalization benefits will accrue to owners of properties located near the Hempstead Lake State Park. Short-term construction economic impacts are primarily considered a transfer of activity from one economic sector to another. Therefore, these activities are not considered as a net benefit to society (and thus not included within the benefit cost ratio). However, the project will contribute to the local economy by supporting jobs in the construction and related industries during the design and construction phases.

Property Value Impacts

There is an extensive body of research that shows that well-maintained parks and open space positively contribute to the value of nearby properties (Crompton, 2001; Shoup, 2010; Trust for Public Land 2008, 2009a, 2009b). Economists often use hedonic pricing techniques to isolate the effect of various attributes, such as proximity to a safe and clean park or pond that can influence property values. Hedonic methods analyze how the different characteristics of a marketed good, including environmental quality, might affect the price people pay for the good or factor. This type of analysis provides estimates of the implicit prices paid for each characteristic, such as number of rooms, and the quality of the adjacent host environment. A hedonic price function for residential property sales might decompose sale prices into implicit prices for the characteristics of the lot (e.g., acreage), characteristics of the house (e.g., structural attributes such as square footage of living area), and neighborhood and environmental quality characteristics. In terms of aquatic ecosystems, properties with closer proximity to these systems may sell for more than similar properties that do not have this adjacency or proximity (NRC, 2005).

Based on an extensive review of existing hedonic pricing studies and other research, in a 2004 report for the National Recreation and Park Association (NRPA) Texas A&M University Professor John Crompton developed a methodology that can be used to estimate the property value premium of parks when it is not feasible to perform an hedonic pricing study. Based on NRPA's methodology, residences within 500 feet of an average or higher quality park benefit from a property value premium of 5 to 15 percent (NRPA, 2004). While there is no conclusive research, it is likely that below average quality parks have a negative effect on the property value of the nearby properties. Park quality scored using a five-point scale as presented in **Figure 3**.

Figure 3: Park Quality Scale for determining proximity premiums

Unusual Excellence: A signature park; exceptionally attractive; natural resource based; distinctive landscaping and/or topography; often mentioned in sales advertisements for nearby properties; well maintained; genuine ambiance; engenders a high level of community pride and "passionate attachment."

Above Average: Natural resource based; has charm and dignity; regarded with affection by the local community; pleasant, well maintained.

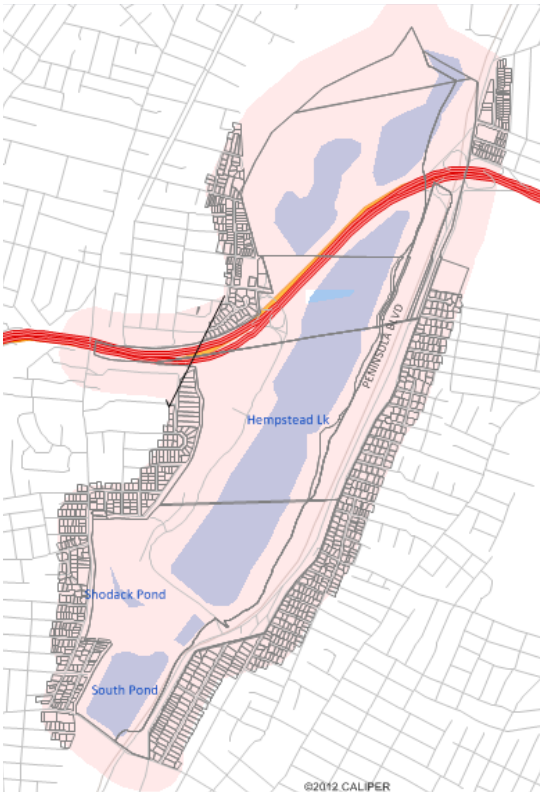
Average: Rather nondescript; not really "noticed" by the local community; adequately maintained; no distinguishing features.

Below Average: Sterile; absence of landscaping or trees; athletic fields with noise, lights, congestion; intensive use.

Dispirited, Blighted: Dilapidated, decrepit facilities; broken equipment; unkempt, dirty; unofficial depository for trash; noisy; undesirable groups congregate there; rejected and **avoided by the community.**

Source: NRPA (2004)

Louis Berger applied the NRPA methodology to estimate the premium for residences near Hempstead Lake Park. A total of 954 residential properties are located within a 500 feet buffer around the park. Based on the property assessment records, these properties have a combined market values of $919.1 million in 2019 (Nassau County Department of Assessment, 2019a). **Figure 4** shows the location of the properties proximate to Hempstead Lake State Park.



Source: Louis Berger: V. Amerlynck, 2019

Figure 4: Hempstead Lake State Park Proximate Properties (within 500' buffer area)

Louis Berger classified the park in its current condition as an average park. Following the improvements included in the Project, Louis Berger assumes the park would become an above average park, which in the five-point NDRC scale is defined as a natural resource based park that has charm and dignity, is regarded with affection by the local community, pleasant and well-maintained. Planned improvements include safety enhancements, trails and bridge connections for pedestrians and cyclists, waterfront improvements, installation of floatable catchers and wetlands cleanup. These improvements would make the park more attractive to residents. Following the NRPA methodology, the property value premium of moving from a below average quality park to an above average quality park is 10 percent.

The cumulative discounted present value of this one-time benefit occurring in 2020 is **$76,861,854**.

Job Creation

During the construction phase, the Project will create jobs in the construction and related industries. The construction cost of the improvements to Hempstead Park, is $35.98 million, including the contingency. In addition to the jobs that will be directly created by the proposed project, additional jobs will be supported through the contractor's purchase of construction materials at other New York State businesses and through the local household spending by construction workers and other workers. Upon its completion, the project will support jobs related to the operations and maintenance (O&M) of the park. Parks personnel man-hours are included in the annual $278,200 O&M budget for the floatables collection system, sediment basin cleaning, filtering wetlands and trail maintenance. Similar to the construction spending, spending on materials and supplies required for the operations and maintenance of the park as well as household spending by its employees will support additional jobs within New York State. While typically not a net benefit to society, job creation constitutes a positive contribution to the New York State economies.

7.1.6 Benefit Cost Analysis Results

Table 7 summarizes the results of the BCA for the Hempstead Lake State Park Project

Table 7: BCA for the Hempstead Lake State Park Project

	Category	Cumulative Present Value (Constant 2018$)
	LIFECYCLE COSTS	**(2019–2069)**
	Project Investment Costs	$32,522,160
	Operations & Maintenance	$3,336,377
[1]	**Total Costs**	$35,858,537
	BENEFITS	
[2]	Resiliency Values	+
[3]	Environmental Values	$7,561,524
	Ecosystem services value of freshwater wetlands marsh	$5,893,224

	Category	Cumulative Present Value (Constant 2018$)
	Water Quality Improvement	$1,668,300
[4]	Social Values	$15,232,861
	Recreation Value of Improved Park Amenity	$12,810,305
	Value of Education and Resilience Center	$2,422,556
[5]	Economic Revitalization Benefits	$76,861,854
	Property Value Impacts ([proximity to Improved HLSP])	$76,861,854
[6]	Total Benefits	$99,656,239
[7]	**Measures of Project Merit:**	
	Benefits less Costs [Net Present Value (Net Benefits @ 7%)]	$63,797,702
	Benefit Cost Ratio (BCR)	2.78
	RBD Rate of Return	92.3%

Measures of RBD Project Merit

- The Hempstead Lake State Project is economically feasible and has a positive benefit cost ratio of 2.78. Benefits are more than two times the cumulative present value of lifecycle costs.
- The cumulative net present value (benefits less costs) is $63.8 million. A project with a positive net present value is an economically viable public project that will add value to the community.
- For a project to be economically feasible, the internal rate of return (IRR) must exceed the discount rate. The RBD rate of return of 92.3%exceeds the HUD recommended project discount rate of 7.0%.

Figure 5 below shows a breakdown of the benefits of the HLSP.

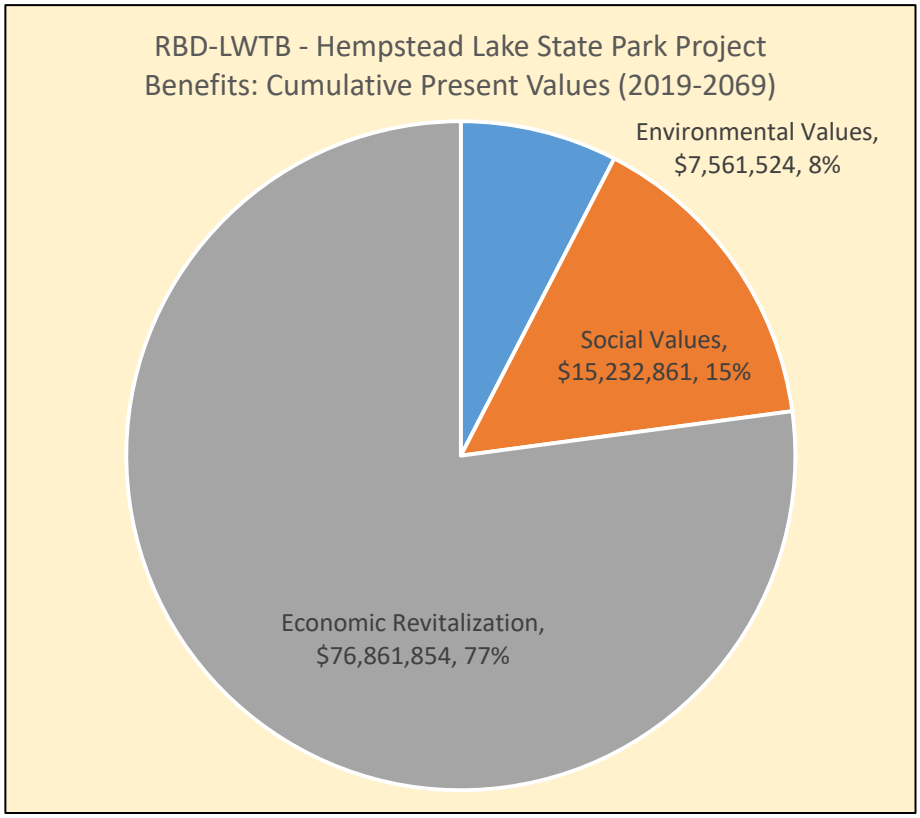


Figure 5: Breakdown of the Benefits of the HLSP

7.2 East Rockaway High School

Background: East Rockaway High School is located on the west bank of Mill River just north of Pearl Street in East Rockaway. Hurricane Sandy severely damaged the school and its grounds, and the faculty parking lot routinely floods. The excess water inundates the parking lot, and given the limited pervious surfaces and inadequate pitch, is likely to run off untreated into the river. The school building and grounds were repaired after Hurricane Sandy, and a recently approved Federal Emergency Management Agency (FEMA) project is intended to mitigate the flooding of the school's buildings. The school's fields remain vulnerable to frequent tidal flooding and shoreline erosion. Due to ongoing shoreline erosion, the grandstand and two-story storage and press box at the sports field are on the verge of failing due to foundation subsidence, creating hazard to the general public and adjacent Mill River. If left unmitigated, continued erosion could threaten the use of the entire field for both sporting and other school activities (GOSR, 2017).

Project Objectives: Shoreline stabilization is currently being evaluated at the school along the eastern portion of the athletic field with design considerations to alleviate the tailwater and surge flooding occurring there. As noted, the grandstand is located at the river bank, where ongoing erosion of the bank is compromising its structural stability. The design proposal provides an elevated bulkhead that stabilizes the river bank and enhances the conditions for the grandstand. The construction of the bulkhead would protect the athletic field from future erosion that could affect scheduling of future athletic events. The top of the proposed bulkhead would be elevated approximately 2 feet above existing grade to accommodate future raising of the existing field by 2 feet proposed as part of a School

District-funded construction project. The proposed level of protection service for the design is elevation 7.25, which is the elevation of the top of the proposed bulkhead along the eastern portion of the School District property.

Green infrastructure improvements would improve the faculty's (teacher's, administrative/maintenance staff, and visitors) parking lot at the high school. Green infrastructure improvements can treat approximately 1.6 cubic feet per second of runoff generated over the parking lot during a 1.5-inch storm event. The 1.5-inch storm event is the water quality storm for the area and is approximately 90 percent of the 1-year storm event per NYS Stormwater Regulations. The improvement would help eliminate standing water and provide a means for the water to percolate naturally through the ground and prevent pollutants and silt from entering the river system, as well as prevent the spread of pathogens from stagnate water. As part of the ERHS Project, two backflow preventers would be installed at outfalls located at Centre Avenue and Roxbury Road. The backflow preventers would stop water from high tides or surge from filling the upstream conveyance system, which would allow more volume of stormwater to be stored and retained below grade, instead of on the surfaces above. Lastly, a generator would be provided to power the entire school facility in the event of power loss due to severe weather events.

7.2.1 Lifecycle Costs

Lifecycle costs consist of both capital construction costs and the long-term annually recurring O&M costs that would be required to maintain the project assets and improvements delivered by the intervention. **Table 8** shows a breakdown of the main capital costs by project component.

Table 8: East Rockaway High School Project Capital Costs by Main Project Element

Proposed Improvement	Approximate Construction Cost	Percent
Back Flow Prevention	$21,500	1.0%
Backup Generator	$300,000	14.0%
Parking Lot Stormwater Improvements	$500,000	23.3%
New Bulkhead with Excavation	$891,697	41.6%
Subtotal:	$1,713,197	80.0%
Contingency (25% of the Subtotal)	$428,299	20.0%
Grand Total	**$2,141,496**	**100.0%**

Sources: GOSR, 2019b; Nasco Construction, 2018

The ERHS Project is expected to cost approximately $2.1 million. The construction of the new bulkhead east of the ERHS sports fields represents the biggest portion of the project's budget at 41 percent of the overall budget. Annual O&M costs of $64,245 were assessed based on an assumption that O&M would be about 3 percent of the capital costs of the project and would consist of maintaining check valves, vacuuming porous pavement, inspecting the flood barrier at the sports field, and regular maintenance

and cleaning of stormwater systems at the ERHS parking lot. This O&M percentage is consistent with other projects in this analysis, such as HLSP.

7.2.2 Resiliency Value

Several measures of resiliency value benefits were calculated based on the avoided cost and risk-adjusted avoided cost method. These included avoided costs to athletic event interruptions, reconstruction of the sports fields and supporting infrastructure, and lost staff time due to regular flooding of the parking lots. Additionally, benefits from the installation of a generator for use in an emergency were also assessed. Avoidance of annually recurring estimates of losses from school activity interruptions and disruptions attributable to nuisance flooding were estimated based on information obtained from ERHS (ERSD, 2017).

Avoided Costs of Athletic Infrastructure Replacement

To estimate the avoided costs of reconstructing the field and grandstand, estimates of the costs to replace these facilities were made based on information obtained from a comparable school district, a field turf construction company, and cost estimates for fill soil. **Table 9** lists the estimated costs to reconstruct the facilities at the sports fields.

Table 9: Estimated Infrastructure Replacement Costs

Facility	Cost
Grandstand	$262,500
Football Field	$700,000
Two Baseball Fields	$1,385,000
Field Hockey Field	$420,000
Earth Movement/Fill	$325,926
Total	**$3,093,426**

Sources: Costhelper home & garden, 2019; FieldTurf, 2019; GOSR, 2019c; Hays CISD, n.d.; Haas, 2018

Based on an analysis by Tetra Tech, it was estimated that erosion of the eastern shoreline of the sports fields at ERHS eroded by 15 feet between 1966 and 2015 (GOSR, 2019c). This translates to an annual rate of 3.67 inches per year. Currently, the grandstand sits about 12 feet from the shore. The eastern shore of the sports fields is an unprotected bank in a floodway that is currently 5 feet high; therefore, the safe slope setback would be based on a 6:1 ratio of horizontal distance to vertical height (NYS DEC, 2016). This means the horizontal setback for any activities or structures should be 30 feet from the shoreline. Because the grandstand is located within this area, it is assumed to presently be at risk of failure. Installation of a bulkhead on the eastern side of the sports fields is expected to prevent this failure. To account for the uncertainty of when or if the grandstand would fail due to erosion and subsidence, an annual probability of failure of 10 percent was applied to the replacement value of the grandstand over a 10-year period, starting with the date of completion of the project. This period of avoided costs assumes that the bulkhead's construction would offset the risks that would otherwise occur over this period.

An average football field has several zones and player areas around it that compose the playable safe area for an official football field. Currently, the edge of this zone is 42 feet from the shoreline, but only 12 feet from the 30-foot no development zone. At the historical rate of erosion, it is estimated that it would take 39 years for the shoreline to erode to the point where the 30-foot buffer from the shore begins to affect the field. Therefore, it is assumed that benefits from the construction of the bulkhead would start 39 years after completion of the bulkhead project. An immediate benefit of $1,025,926 was assumed to occur in that year, 2058, because a loss of any part of the field is assumed to result in a total loss of the field because a football game cannot be played on a partial field. This value was developed by assuming that the entire field and earth movement associated with the entire site would need to occur now.

All other losses at the sports field from shoreline erosion would occur outside the 50-year time horizon of this BCA. However, a storm event of sufficient magnitude could render the entire sports field complex inoperable sooner than erosion assets of the field. For the purposes of estimating this level of impact, it was assumed that a 250-year storm would be of sufficient magnitude to cause extensive rapid erosion of the sports field complex such that the entire sports field would be lost. To map the benefit that the bulkhead would provide, it is assumed that the bulkhead would protect the field from an annual 1 in 250 chance of this storm (250-year storm) occurring in any given year. The cumulative present value of this avoided cost was equal to **$420,582** over the 50-year project evaluation period.

Avoided Athletic Event Interruption Costs

As noted above, disruptions to physical education activities and athletic events and cancelled sport contests have been a frequent, recurrent problem for ERHS. These disruptions have negatively affected the high school experience for many student athletes. According to the Athletic Director, the average loss of time for physical education and athletic events on the playing fields averaged 30 percent of the year over his 20-year tenure as director (ERSD Memo, 2015). While many of these impacts on students (and coaches) are intangible and cannot be quantified, because they have occurred so frequently, this BCA attempts to recognize a minimum value for such losses. To quantify and monetize the annually recurring loss that would be avoided with the project infrastructure and drainage improvements in place, the calculation described in the following paragraph was performed.

Table 10 shows budget data sourced from the East Rockaway School District that reflects average expenditures per student. While these expenditures cover all activities, the data were expressed on an average hourly basis to show the opportunity cost of lost and interrupted athletic events. **Table 10** converts the average student budget spending to an hourly figure for working purposes. Assume that for one fall season, approximately 166 student athletes take part in extracurricular team events. The school's website lists the following fall season duration and team events: Fall Sports all football, cheerleading soccer, volleyball, cross country, tennis (ERHS Athletics, 2019).

Table 10 then converts a percentage of lost activity days attributable to unusable field and facilities to a monetary value in hours based on the estimated number of students who would have experienced cancellations and activity disruptions and relocations. The estimated lost activity cost was based on assuming a two-hour hourly budget cost of "inconvenience" per each student athlete. Summed over an estimated 22 lost activity days per student athlete, this opportunity cost amounts to $150,067 per year (for one season). The final two rows (15 and 16) of this table provide an estimate of the likelihood that

ERHS can raise the sports fields to avoid these athletic event interruptions. The likelihood of this project occurring is conservatively estimated at 10 percent.

Table 10: Data Applied in Estimating Avoided Athletic Event Interruption Costs

	Calculation Element / Assumption	Value
1	ER School District average annual spending per student \a	$33,427
2	ERHS number of students \b	554
3	Estimated number of school days:	180
4	Spending per day per student	$185.71
5	Hourly spending (assumes 8 am to 4 pm)/per student (=spend day/8)	$23.213
6	Estimated no. students who participate in athletics, %	30%
7	Number of student athletes	166.2
8	Semester athletic season (assume 3 months, for fall or spring) practice days+event days (=6 d/wk x 4wk/m x 3 mo) (one season)	72
9	Lost or interrupted sports days (% of year), applied per season \c	30%
10	Lost days per one sports season	21.6
11	Lost days for all student athletes	3,590
12	Budget value of a lost/disrupted sport day (assume 2 hours)/per student	$46.43
13	Budget value of lost sports days (all student athletes) (one example sports season)	$166,667
14	Value of lost / disrupted sports days (for 2 seasons, fall and spring)	$333,334
15	Probability that ERHS would be allowed to raise the sports fields	10%
16	Annual value of reduction in lost / disrupted sports days	$34,148

Sources: \a Empire Center, 2017; \b AreaVibes.com, 2019; \c ERSD Memo, 2015

The annual value in reduction of interruptions or loss in sports events is $34,148. Additionally, the remaining 70 percent of sports days that are currently not lost or interrupted have a 1 in 250 chance of being interrupted in the event of a 250-year storm as stated above. Therefore, the installation of the new bulkhead would avoid this potential additional cost estimated at $3,111 per year. The cumulative present value of these avoided costs is equal to **$392,736** over the 50-year project evaluation period.

Avoided Parking Lot Staff Time Costs

Nuisance flooding of the ERHS parking lot has burdened staff and has forced them to leave the school building to move their cars to surrounding streets and then walk back to the building. These events have recurred approximately 5–10 times per year, especially when there are heavy rains in the springtime. It has been estimated that it takes approximately 40 to 50 minutes for staff to leave the building, walk to

the parking lot, move their cars to surrounding streets, and then walk back to the building. The footprint area of the property that does not flood is quite small (ERSD, 2017).

Table 11 shows this information and data and additional information on average salaries that are used to estimate a monetary cost of this unnecessary and burdensome activity that would be avoided by the ERHS Project's structural and drainage improvements.

Table 11: Data Applied in Estimating Avoided Parking Lot Staff Time Costs

	Value	Unit
Number of staff cars in parking lot \a	60	No.
Frequency of parking lot floods/yr. \a	10	No./yr.
Amount of time necessary to move car from lot \a	50	Minutes
Average salary (high school) \b	$85,601	$/yr.
Average hourly wage rate	$41.15	$/hr.
Cost per 45-minute (work day interruption)	$30.87	
Total cost for 60 cars (50 min. work day interruption)	$1,851.95	Cost/event
Total cost for 10 flood events in a year	$18,519.45	Annual Cost

Sources: \a ERSD, 2017; \b TeacherSalaryinfo.com, 2017

Average annual salary information for ERHS was converted to an average hourly wage rate and the time spent in moving and parking cars was calculated. For 60 parking spaces and 10 flood events per year, the annual opportunity cost of this nuisance flooding on staff lost time is $18,519. This calculation does not include the lost time spent with students and others caused by these interruptions that can impact a much larger number of individuals, also in intangible ways that are not monetized in this BCA.

The cumulative present value of this avoided cost is equal to **$222,099** over the 50-year project evaluation period.

Generator Benefits

This project would install a generator to provide emergency power during events. This generator is assumed to provide power so that the school can act as an emergency shelter during storm events, or to provide power for the school for continued operation as a place of student learning and congregation during a power outage. The generator would not be used to support the use of the school as an emergency command center. During Hurricane Sandy, each shelter in the New York City area housed approximately 349 people (SmartSign, 2019; GSA, 2019). To provide a conservative analysis, this BCA assumes 87 people (one quarter the number housed during Hurricane Sandy) would be housed at ERHS during a hurricane or other emergency event as a result of the installation of this generator and are assumed to spend an average of two nights at the school during this period. Based on the per diem rate of hotel costs in the area around the school and the annualized likelihood of a 100-year flood, the cumulative present value of this benefit was **$777** over the 50-year project evaluation period.

7.2.3 Social Value

There may be some unquantifiable improvement to the living environment surrounding ERHS as a result of the stabilization of the bank on the eastern side of the sports fields and parking lot drainage improvements. If the sports fields are allowed to continue to erode, a piece of the community's identity and social cohesion could be lost. The repair of the parking lot and improvement in draining of the lot may result in the reduction in occasional community blight conditions that accompany the flooded parking lot. Overall, these benefits would result in a + (positive impact) in terms of social value in the community.

7.2.4 Environmental Value

The primary environmental values of this project would be associated with the treatment of stormwater as a result of green infrastructure improvements in the staff parking lot. Without these improvements, this stormwater would enter the Mill River. This analysis conservatively assumes that 20 percent of the approximately 35,000-square-foot staff parking lot along the river would be reconstructed of porous pavement. As described for the other projects, allowing stormwater to infiltrate and be absorbed back into the ground, through project elements like porous pavement, could reduce stormwater contributions to runoff and reduce high-velocity, poor water quality contributions to the Mill River. The environmental values of these permeable assets were quantified by applying the Green Infrastructure calculator (CNT and American Rivers, 2010). The calculator quantified the gallons of stormwater runoff that would be absorbed and filtered by the bioswales and trees allocated to this project. The cumulative present value of the annual green infrastructure benefit from porous pavement was equal to $2.3 million over the 50-year project evaluation period.

7.2.5 Economic Revitalization

Upon completion of the project, some economic revitalization benefits may accrue to owners of properties located near the ERHS. These benefits could result from the reduced likelihood that the nearby ERHS would flood, potentially helping property values in the area. Short-term construction economic impacts are primarily considered a transfer of activity from one economic sector to another. Therefore, these activities are not considered as a net benefit to society (and thus not included within the benefit cost ratio [BCR]). However, the project would contribute to the local economy by supporting jobs in the construction and related industries during the design and construction phases. Overall, these benefits would result in a + (positive impact) in terms of economic revitalization in the community.

7.2.6 Benefit Cost Analysis Results

Table 12 summarizes the results of the BCA for the ERHS Project.

Table 12: Benefit Cost Analysis RBD-Living with the Bay East Rockaway High School Project

	Category	Cumulative Present Value (Constant 2018$)
	LIFECYCLE COSTS	**(2019–2069)**
	Project Investment Costs	$1,935,932

	Category	Cumulative Present Value (Constant 2018$)
	Operations & Maintenance	$770,471
[1]	**Total Costs**	$2,706,404
	BENEFITS	
[2]	Resiliency Values	$1,036,194
	Generator Benefits	$777
	Avoided Athletic Event Interruption Costs	$392,736
	Avoided Parking Lot Staff Time Costs	$222,099
	Avoided Costs of Athletic Infrastructure Replacement	$420,582
[3]	Environmental Values	
	Porous Pavement Contribution	$2,349,533
[4]	Social Values	+
[5]	Economic Revitalization Benefits	+
[6]	**Total Benefits**	**$3,385,727**
[7]	**Measures of Project Merit:**	
	Benefits less Costs [Net Present Value (Net Benefits @ 7%)]	$679,323
	BCR	1.25
	RBD Rate of Return	9.7%

Measures of RBD Project Merit

- The ERHS Project is economically feasible and has a positive BCR of 1.25. Benefits are more than the cumulative present value of lifecycle costs.
- The cumulative net present value (benefits less costs) is $679,323. A project with a positive net present value is an economically viable public project that will add value to the community.
- For a project to be economically feasible, the IRR must exceed the discount rate. The RBD rate of return of 9.7 percent exceeds the HUD-recommended project discount rate of 7.0 percent.

Figure 6 below shows a breakdown of the benefits of the ERHS Project.

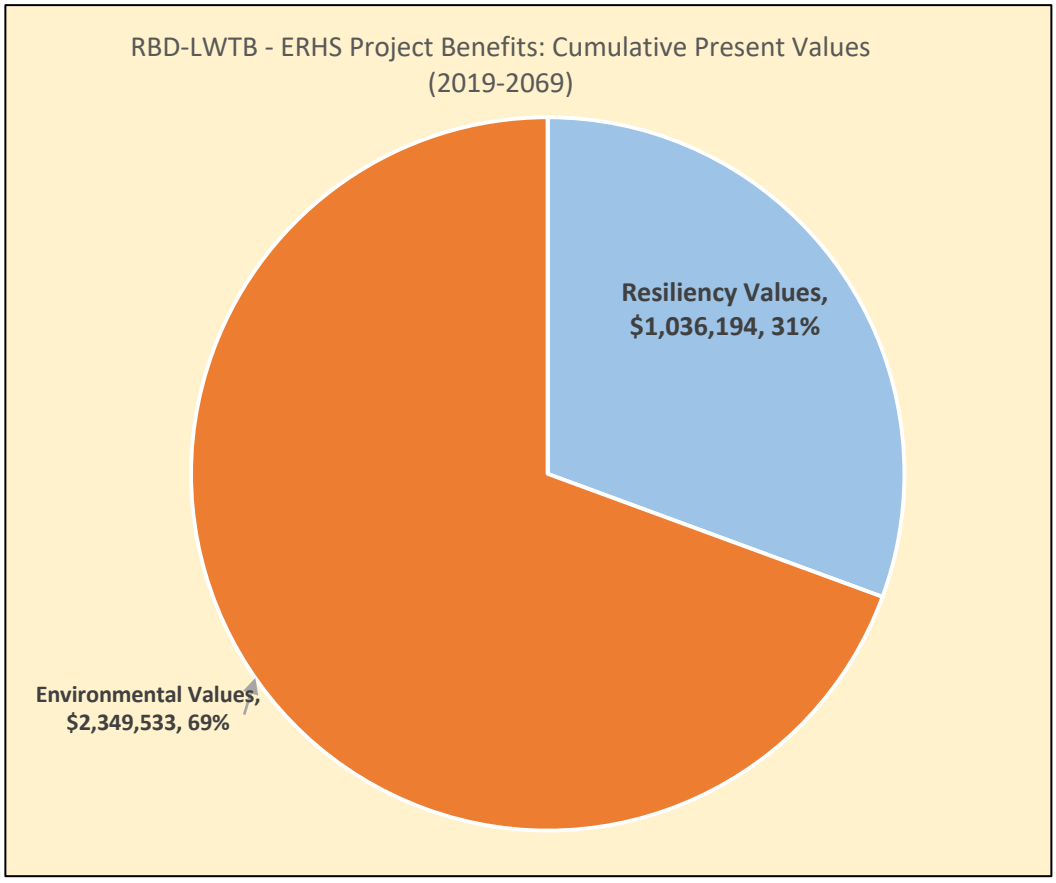


Figure 6: Breakdown of the Benefits of the ERHS Project

7.3 Smith Pond

Background: Smith Pond is a 22-acre freshwater pond located in the center of the LWTB project area in the Village of Rockville Centre, New York. It is the confluence point of the two primary drainage branches (Pines Brook and Mill River), conveying water from the north end of the Mill River Watershed. As a result, it receives both the flow (water quantity) and the nutrient loads (water quality) for the entire watershed. Smith Pond is also a unique location as the connecting water body between the upper freshwater system and the lower tidal and salt water system. There is a historical account of invasive plants in the pond that inhibit sunlight from penetrating the water column and create anoxic conditions when the plants perish and decompose.

Project Objectives: The objectives of the Smith Pond Project are to improve flood control, increase storm runoff attenuation capacity, improve water quality and habitat quality. The Smith Pond intervention would also provide improved water and debris management, to avoid negative impacts downstream on receiving water bodies, in terms of both water quantity and quality. Smith Pond has been identified as a key site for restoration and intervention.

Several resiliency interventions have been proposed at Smith Pond, including the following:

- Improving the existing weir and installing a fish ladder and eel passage near the southeastern corner of the pond
- Rebuilding a scenic overlook near Peninsula Boulevard
- Constructing a new access drive to access Smith Pond spillway
- Constructing approximately 1,800 linear feet of flood walls with flood breaks
- Enhancing existing wetland communities by removing invasive species
- Improving social value within the surrounding community by enhancing recreational activities

Work at Smith Pond would largely focus on improving fish habitat by refurbishing the existing weir and installing a fish ladder and eel passage, both of which would improve habitat for American eel and river herring. The scenic overlook would also be available to recreational fishers. Mechanical removal of existing and invasive plant material would support fish habitat. High nutrient loads, silt, sedimentation, and excessive weed growth have adversely affected recreational uses and had negative effects on aquatic life. The Mill River Greenway would also be expanded along the eastern bank of the pond, but this improvement is analyzed separately in the *Greenway Project* section of this BCA.

7.3.1 Lifecycle Costs

Lifecycle costs consist of both capital construction costs and the long-term annually recurring O&M costs that would be required to maintain the project assets and improvements delivered by the intervention. **Table 13** shows a breakdown of the main capital costs by project component.

Table 13: Smith Pond Project Capital Costs by Main Project Element

Scope	Unit	Quantity	Unit Cost	Total
Shoreline Stabilization	CY	6000.0	$15.00	$90,000.00
Permeable Pavement - Parking Lot	SF	65000.0	$18.00	$1,170,000.00
Weir Restoration	CY	533.0	$1,000.00	$533,000.00
Living Shoreline	SY	5555.6	$100.00	$555,555.56
Landscaping	AC	10.0	$40,000.00	$400,000.00
Lighting	EA	71.0	$1,500.00	$106,500.00
Site Prep	LS	1.0	$100,000.00	$100,000.00
Fish Ladder	CY	100.0	$1,500.00	$150,000.00
FFE and Signage	EA	50.0	$2,000.00	$100,000.00
Removal of Invasive Species	AC	12.0	$25,000.00	$300,000.00
Conduit	LF	2500.0	$175.00	$437,500.00
Overlook Rebuild	LS	1.0	$75,000.00	$75,000.00
Flood Walls	CY	155.6	$1,900.00	$295,555.56

Scope	Unit	Quantity	Unit Cost	Total
Flood Walls - pile sheathing	LF	2600.0	$750.00	$1,950,000.00
Subtotal				**$6,263,111.11**
Contingency			15%	$939,466.67
Design Survey and Permitting			20%	$1,252,622.22
Construction management			10%	$626,311.11
Grand Total				**$9,081,511.11**

The Smith Pond Project is expected to cost approximately $9.1 million. The costs are based on estimates prepared by the GOSR for the purposes of this BCA and should not be treated as final. The estimates are included here as "best available" costs for the purposes of this BCA and represent a conservative estimate for elements included in the BCA. O&M costs were estimated based on comparable costs for similar projects and are estimated at $70,000 primarily for floodwall maintenance. Both flood walls and flood gates would require regular paint, concrete, inspection, repair, and general maintenance to remain in operation. Benchmark repairs have been chosen based on comparable estimates in the region (Arcadis, 2017). The pervious pavement annual O&M cost is based on a per acre vacuum sweeping and high-pressure jet hosing and inspection cost for porous pavement. Floodwall maintenance is required to reduce loss of material at the base of the structure and to prevent the erosion of the soil due to contact with water. At the time of the BCA, additional O&M costs for other elements were not available. Note that all greenway costs have been excluded from this estimate (including contingency, design, and construction management), which would account for approximately $543,750 of the project costs.

7.3.2 Resiliency Values

The resiliency values were calculated by estimating the value of the project elements that would store water and provide detention and water management services, pollutant removal services, and energy savings. Environmental values associated with wetlands benefits are described in the *Environmental Value* section. For this section, the water quantity and water quality benefits are described as they relate to resilient pond feature improvements. Several Smith Pond project elements (permeable pavement and trees) benefits were estimated by applying the Green Infrastructure calculator (CNT and American Rivers, 2010). For the permeable pavement, the calculator quantified the combined gallons of stormwater from receiving and drainage areas. This runoff benefit for the two parking lots was valued on an avoided cost basis by applying unit values reflecting treatment (per gallon) within Nassau County (New York State, 2017; Nassau County, 2017). The Green Infrastructure calculator also quantified the avoided electricity savings in (in kilowatt hours) and dollars associated with surface water treatment, the avoided criteria air pollutants, and carbon dioxide reductions from energy saved.

Table 14 shows the monetized values by each category and by each project element for the Smith Pond Project.

Table 14: Smith Pond Annual Benefits from Green Infrastructure Project Features

Parameter	Trees	Permeable Pavement	Combined Total
Stormwater	$383	$71,854	$72,237
CSO-Based Value	$14,352	$2,690,522	$2,704,874
Electricity	$36	$277	$313
Natural Gas	$85	$0	$85
Ozone	$11	$0	$11
Nitrogen Dioxide	$27	$11	$38
Sulfur Dioxide	$13	$4	$18
PM_{10}	$22	$0	$22
Carbon Dioxide	$65	$73	$139
Subtotal	$14,995	$2,762,741	$2,777,736

Sources: CNT and American Rivers, 2010; Nassau County, 2017; EPA, 2014

Flood walls would improve the resiliency of surrounding infrastructure, such as Ocean Avenue and Merrick Road, both of which are located proximate to FEMA Zone A (areas subject to inundation by the 1-percent-annaul-chance flood). FEMA's Baseline Standard Economic Value Methodology Report provides guidance for providing an economic value of delays from road closures based on the value of lost time. This methodology relies on an estimate of the percentage of vehicles on the road that are personal passenger vehicles and the percentage that are commercial, based on typical vehicle trends as observed in the National Highway Transportation Statistics and Annual Average Daily Travel on Ocean Avenue and Merrick Road. Personal vehicles are reimbursed at 50 percent of the wage rate, while commercial vehicles are reimbursed at 100 percent of the wage rate. Finally, the average number of persons per vehicle as reported in the National Highway Transportation Statistics is used to estimate the total number of person-hours lost for each incident. The value lost is approximately $36.23 per hour for lost time. In this case, it is assumed that users would lose, on average, 15 minutes over a three-day period following a 100-year storm. Because the floodwall also provides protection against a 25-year flood, it was assumed that drivers would also lose approximately 15 minutes over a half a day period with an annual probability of approximately 4 percent.

The cumulative present value of the annual value of combined green infrastructure and increased pond storage impoundment was estimated to be $33,564,115 over the 50-year project evaluation horizon.

7.3.3 Social Value

The social value estimate is based on the enhanced freshwater fishing recreation utility value from residents and visitors who would visit the park to take advantage of improved fishing amenities, including the newly reconstructed fishing gazebo. The proposed fish ladder would support the pond by providing suitable spawning habitat for herring and growth of young American eels to reach maturity and return to the estuary. Herring reproduction would contribute to improved recreational fisheries in the pond and downstream in the bay for other recreational and commercial fish by increasing the prey

base for other fish, including bass. The U.S. Forest Service estimated that the average economic value of recreation benefits (use value) for fishing in the northeast was equal to $62.22 (adjusted to 2018 dollars) per person per day in 2016. Conservatively estimating one visitor per day during the open season on bass fishing (mid-June to November 30 every year) and three visitors on weekends, the cumulative present value of the annual value of recreational fishing was estimated to be $188,287.

7.3.4 Environmental Value

The environmental values associated with Smith Pond were assessed based on the number of acres of improved wetland and corresponding water quality. The annual average benefit per acre of preserved water quality was applied to the 4.22 acres where plant removal would protect water quality. A benefits-transfer approach was applied to value the 4.22 acres of incremental quality to Smith Pond based on applying the national annual average benefit values per acre for individual ecosystem services per year produced by wetlands mitigation required under Section 404 of the Clean Water Act (Adusumilli, 2015). Because wetlands would be improved, as opposed to created, one quarter of the per-acre benefit was applied. The cumulative present value of the improved pond water quality was estimated to be $117,742.

7.3.5 Economic Revitalization

Upon completion of the project, economic revitalization benefits would accrue to owners of properties located near Smith Pond. Short-term construction economic impacts are primarily considered a transfer of activity from one economic sector to another. Therefore, these activities are not considered as a net benefit to society (and thus not included within the BCR). However, the project would contribute to the local economy by supporting jobs in the construction and related industries during the design and construction phases.

Property Value Impacts

As described above for HLSP, there is an extensive body of research that shows that well-maintained parks and open space positively contribute to the value of nearby properties. Economists often use hedonic pricing techniques to isolate the effect of various attributes, such as proximity to a safe and clean park or pond that can influence property values (NRC, 2005). NRPA developed a methodology that can be used to estimate the property value premium of parks when it is not feasible to perform a hedonic pricing study (Crompton, 2004). Based on the methodology, residences within 500 feet of an average or higher quality park benefit from a property value premium of 5 to 15% (Crompton 2004). Louis Berger applied this NRPA methodology for parks (**Figure 8**) to estimate the premium for residences near Smith Pond. A total of 81 residential properties are located within a 500-foot buffer around the park. Based on the property assessment records, these properties had a combined market value of $56.1 million in 2019.

Source: Louis Berger, 2017

Figure 7: Smith Pond Proximate Properties (Within 500-Foot Buffer Area)

Assuming a 10 percent premium for the improvement in the park quality, which corresponds to the property value premium according to the NRPA methodology of moving from a below average quality or blighted park to an above average quality park, the proximate home values would receive a one-time premium equal to $5,610,700. Assuming the construction would be completed by 2022, the total discounted present value of this property value premium would be $4,580,002.

Job Creation

During the construction phase, the project would create jobs in the construction and related industries. Based on the 30% design, the construction cost of the improvements to Smith Pond could cost approximately $4.4 million, including the contingency. In addition to the jobs that would be directly created by the proposed project, additional jobs would be supported through the contractor's purchase of construction materials at other New York State businesses and through the local household spending by construction workers and other workers. Upon its completion, the project would support jobs related to the O&M of the pond and park. Similar to the construction spending, spending on materials and supplies required for the O&M of the park as well as household spending by its employees would support additional jobs within New York State. While typically not a net benefit to society, support for jobs in the construction industry constitutes a positive contribution to the New York State economy.

7.3.6 Benefit Cost Analysis Results

Table 15 summarizes the results of the BCA for the Smith Pond Project.

Table 15: BCA Results for Smith Pond Project

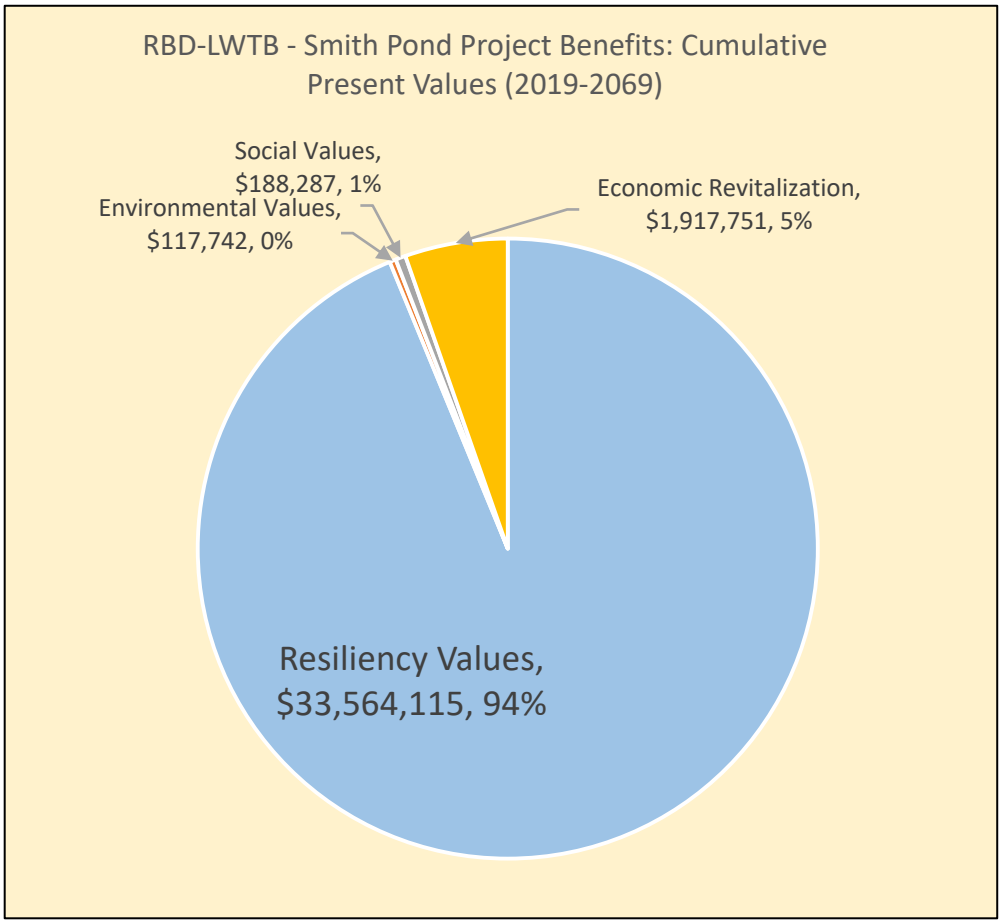
	Category	Cumulative Present Value
	LIFECYCLE COSTS	**(2019-2069)**
	Project Investment Costs	$8,209,769
	O&M	$839,491
[1]	**Total Costs**	$9,049,260
	BENEFITS	
[2]	Resiliency Values	$33,564,115
	Value of avoided traffic delays for roads	$236,185
	Water Storage from Floodwall	$15,302
	Permeable Pavement Contribution	$33,132,800
	Trees Contribution	$179,828
[3]	Environmental Values	$117,742
	Value of Improved pond Water Quality	$117,742
[4]	Social Values	$188,287
	Recreational and Commercial Fishing Value	$188,287
[5]	Economic Revitalization Benefits	$4,580,002
	Property value impacts of improved park amenity	$4,580,002
[6]	**Total Benefits**	**$38,450,146**
[7]	**Measures of Project Merit:**	
	Benefits less Costs [Net Present Value (Net Benefits @ 7%)]	$29,400,887
	BCR	4.25
	RBD Rate of Return	40.0

Note: Costs represent the discounted present value of the nominal projected costs (over 2020-2021). Therefore, they will appear smaller than the nominal costs due to the application of the 7% HUD recommended discount rate.

Measures of Smith Pond Project Merit

- The Smith Pond Project is economically feasible and has a positive BCR of 4.25. Benefits are more than three times the cumulative present value of lifecycle costs.
- The cumulative net present value (benefits less costs) is $29.4 million. A project with a positive net present value is an economically viable public project that will add value to the community.
- For a project to be economically feasible, the IRR must exceed the discount rate. The RBD rate of return of 40.0 percent exceeds the HUD recommended project discount rate of 7 percent.

Figure 8 shows a breakdown of the benefits of the Smith Pond Project.



7.4 Greenway Project

Project Objectives: Continuous safe pedestrian pathways from the residential areas to the waterfront in the LWTB project area are limited, and if they exist, are fragmented with little connectivity for significant lengths. The awarded RBD LWTB project noted that the overall scale and existing land use of the project area makes it ideal for biking, walking, and boating, but existing routes toward or along the river and bay are ad-hoc and discontinuous, and the adjacent neighborhoods' access to the river is poor. Combining this fact with the potential degradation of stormwater management and environmental habitat has created a concern for the sustainable resilience of the community.

Project Description: The RBD LWTB design calls for the landscapes along Mill River to be interconnected into a strong "blue green" framework in order to improve public accessibility and visibility of the Mill River as a means to increase safety and enhance the ecological and landscape value of this historical water course. It would also increase recreational opportunities for the densely populated communities around the river. The development of a continuous greenway is intended to be a strong feature for the suburban layout along and adjacent to the Mill River, thus transforming it into an attractive public amenity. The intent is to take the currently disconnected recreational and open resources in the LWTB project area, as well as schools, and link them into a coherent system of pedestrian and bike paths, to

create a new blue green identity. Another goal of the greenway component of the project is to adopt and develop new sites along the Mill River that are presently underutilized and/or not accessible and make these sites productive towards the LWTB objectives.

The design level of service elements of the multiuse path would, where practical, typically include 10-foot-wide permeable pavement with water storage and infiltration under the path. As a linear element and where space permits, the paths may serve as interceptors of surface stormwater runoff through parallel bioswales, the benefits of which are assessed in other projects (Hempstead Lake State Park, Lister Park, etc.).

7.4.1 Lifecycle Costs

Lifecycle costs consist of the capital construction and long-term running or operational costs estimated to maintain the greenway. **Table 16** shows the estimated capital costs for the Greenway Project. In the BCA, the high cost estimate was applied to be conservative and to reflect the possibility of additional costs contingencies.

Table 16: Greenway Project Capital Costs

Project	High Estimate
HLSP	$412,258
Smith Pond	$375,000
Lister Park	$489,231
Revised Route (Added)	$3,565,641
Separate Proposed Greenway Components	$6,193,275
Total	**$11,035,405**

The main project elements are likely to include permeable pavement and materials, water filters, excavation, greenway signage, ADA compliance, and trail markers, and linkage construction and associated structures needed to enable the greenway concept, at various watershed nodes, to create a contiguous uninterrupted path with enhanced access features. Long-term O&M costs were estimated at 2.5 percent of capital costs. Maintenance costs associated with maintaining porous pavement (to a high function) can consist of vacuum sweeping and high-pressure jet hosing and inspection costs.

7.4.2 Resiliency Value

The main resiliency values associated with the greenway are based on the permeable pavement values and their contribution to stormwater flood risk mitigation and attenuation of stormwater nuisance flooding events by improving the remnants of the Mill River floodplain within an urban setting. Allowing stormwater to infiltrate and be absorbed back into the ground can reduce stormwater contributions to runoff and high velocity poor water quality contributions to the Mill River and downstream catchment areas.

The resiliency and environmental values quantified for the Greenway Project were estimated by applying the Green Infrastructure calculator (CNT and American Rivers, 2010). The calculator quantified

the gallons of stormwater runoff that would be absorbed and filtered by the urban greenspace allocated to the greenway. The calculator also quantified the pounds of criteria air pollutants that would be removed by trees and vegetation, the pounds of carbon dioxide that would be sequestered, and energy savings. Unit values, per pound of pollutant removed and per gallon of stormwater runoff reduced were also applied.

Of the 9.14 miles of greenway that would be constructed as part of this project, it was assumed that only the 750 linear feet of greenway within Lister Park would be new permeable pavement constructed on top of an existing impermeable surface. Portions of the greenway at HLSP and Smith Pond would be constructed on top of already existing permeable surfaces, and the remainder of the new greenway would be constructed on top of existing impermeable surfaces. The cumulative present value of the resiliency value over the project evaluation period was estimated to be **$2,579,187.**

7.4.3 Social Value

Greenway benefits include (i) creating value and generating economic activity, (ii) improving public health through active living, and providing a convenient urban area for this use, and (iii) enhancing cultural awareness and community Identity. The trails and their signage/educational mission can also provide a living classroom experience for users. This BCA quantifies and monetizes the recreational benefits of the greenway that reflects per user per day utility values for biking, walking/hiking, bird watching and wildlife viewing, and general recreation.

An estimate of enhanced trail usage per mile of 16,181 persons was conservatively used to determine the number of additional trail users that would use new or improved portions of the greenway. Ten percent of the greenway trail was assumed to be new trail where no trail existed previously, and this new portion of the trail would attract users at a rate of 16,181 persons per mile. The remaining 90 percent of the trail would be improved and would experience a 10 percent increase in visitation over the 16,181 persons per mile baseline estimates. A value per visit of $54.91 was used to assess the annual value of visitation that would be impacted by improvements or construction of the greenway trail. This value reflects the primary uses of the greenway: general recreation, wildlife viewing, leisure bicycling, and walking/hiking. The annual total value of visitation was estimated to be $1,542,284 per year. The cumulative present value of the quantified social value over the project evaluation period was estimated to be **$18,496,193. Table 17** shows the values used in this assessment.

Table 17: Data Applied to Estimate Greenway Trail Incremental Recreational Usage

Element	Value	Unit
Estimate of Miles of New or Improved Greenway	9.14	Linear Feet
Linear Feet in a Mile	5,280.0	Linear Feet
Average Attendance/Mile	16,181	Trail Users/mile
Assumed New Greenway (10%)	0.91	Mile
Assumed Improved Greenway (90%)	8.22	Mile
Greenway Annual Visits Because of New Trail	14,784	Greenway Trail Usage Visit/Year

Element	Value	Unit
Greenway Annual Visits Because of Improved Trail	13,305	Greenway Trail Usage Visit/Year
Total Incremental Annual Increase in Visits	28,089	Greenway Trail Usage Visit/Year
Value Per Visit	$54.91	$
Annual Value of Visits (Use Value)	$1,542,284.00	Trail Usage Visits x Rec Use Value/Day ($)
Recreation Use Values per Person per Day by Primary Activity-Northeastern Region \a		
Activity	**Value/person/day**	
General Recreation	$35.37	
Wildlife Viewing	$61.24	
Leisure Bicycling	$48.68	
Hiking	$74.33	
Average:	$54.91	

Sources:
Hempstead Lake State Park, 2017; GOSR, 2018, 2019b; Amy S. Greene Environmental Consultants, 2019
a\ RUVD, 2016

7.4.4 Environmental Value

The environmental values that were quantified and monetized for the Greenway Project reflect the value of the atmospheric gas and climate change regulating ecosystem services provided by the greenway. The climate and atmospheric gas regulation function associated with urban greenspaces was estimated by applying a benefits-transfer value to the estimated number of greenway acres. The value per acre applied was estimated at $443/acre (Gas & Climate Regulation; Costanza et al., 2006). The cumulative present value of the ecosystem services provided by urban greenspaces was estimated to be **$31,033,290** over the 50-year project evaluation period.

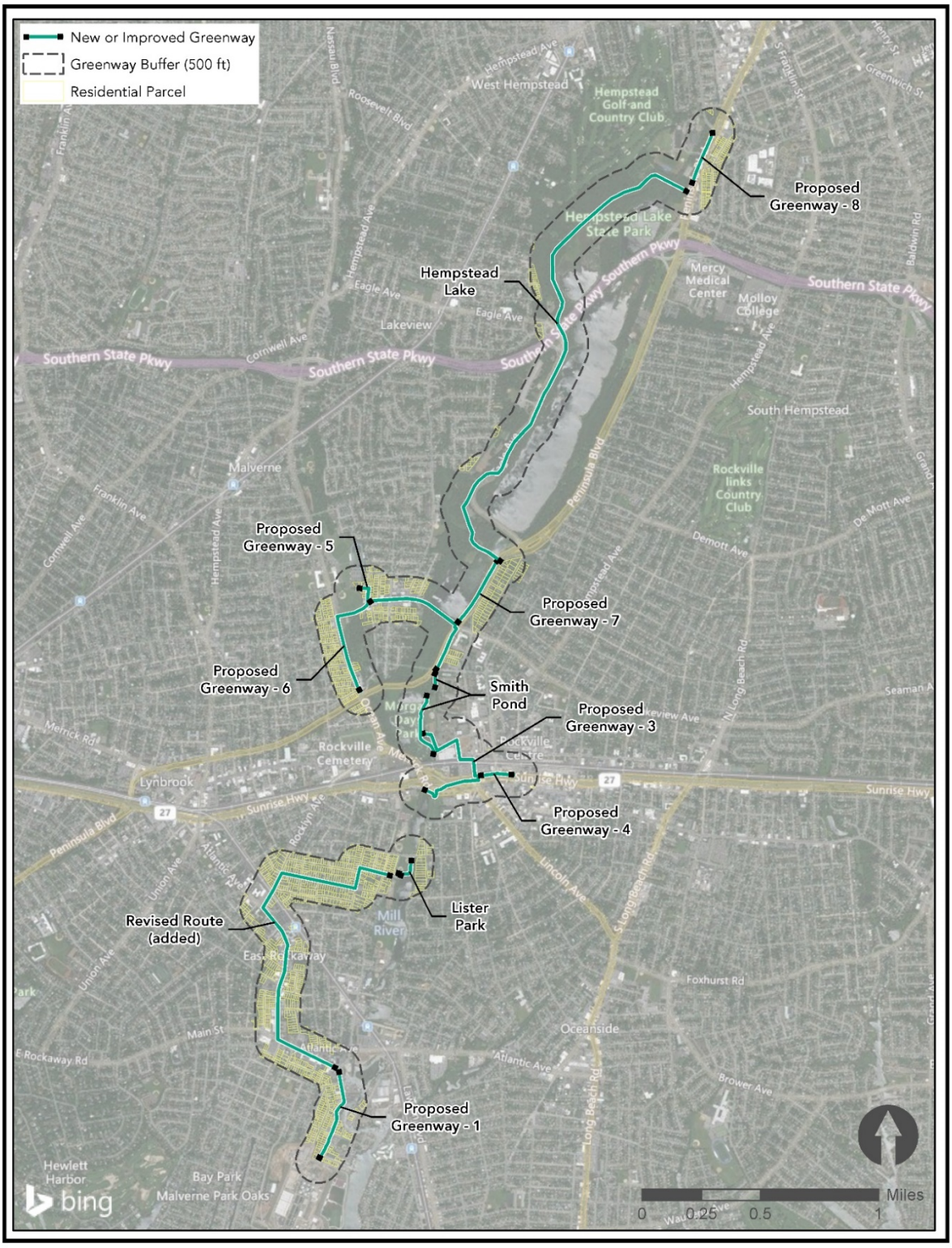
7.4.5 Economic Revitalization

Upon completion of the Greenway Project, economic revitalization benefits would accrue to property owners and/or residents located near the greenway. Short-term construction economic impacts are primarily considered a transfer of activity from one economic sector to another. Therefore, these activities are not considered as a net benefit to society (and thus not included within the BCR). However, the project would contribute to the local economy by supporting jobs in the construction and related industries during the design and construction phases, as well as post construction maintenance phases.

Property Value Impacts

As described above for the other project elements linked to the greenway, there is an extensive body of research that shows where well-maintained parks and green open spaces positively contribute to the value of nearby residential and commercial properties. Economists often apply hedonic pricing techniques to isolate the effect of various attributes, such as proximity to a safe and clean park, pond or urban greenway, which can influence property values (NRC, 2005). NRPA developed a methodology that can be used to estimate the property value premium of parks when it is not feasible to perform a hedonic pricing study (Crompton, 2004). Based on the methodology, residences within 500 feet of an average or higher quality park benefit from a property value premium of 5 to 15 percent (Crompton, 2004). Louis Berger applied this NRPA methodology for parks to estimate the premium for residences near the Greenway footprint.

A total of 1,209 residential properties are located within a 500-foot buffer of the greenway. Based on the property assessment records, these properties had a combined market value of $912.7 million in 2019 (Nassau County Department of Assessment, 2019a). **Figure 9** shows the location of the properties proximate to the greenway.



Source: ESRI, 2019; NYS Department of Taxation and Finance, 2018; GOSR, 2019c

Figure 9: Greenway Proximate Properties (Within 500-Foot Buffer Area)

The property value impact calculations have all been adjusted for potential double counting of the greenway segments that are part of the other LWTB projects evaluated. The Greenway Project residential parcels only reflect those that are nearest to this project element. Assuming the construction would be completed in 2022, the total discounted present value of this property value premium is **$38,159,610**.

Job Creation

During the construction phase, the project would create jobs in the construction and related industries. In addition to the jobs that would be directly created by the proposed project, additional jobs would be supported through the contractor's purchase of construction materials at other New York State businesses and through the local household spending by construction workers and other workers.

Upon its completion, the project will support jobs related to the O&M of the greenway and upkeep of permeable pavement, trails and signage. Similar to the construction spending, spending on materials and supplies required for the O&M of the greenway as well as household spending by maintenance workers would support additional jobs within New York State. While typically not a net benefit to society, job creation constitutes a positive contribution to the New York State economy.

7.4.6 Benefit Cost Analysis Results

Table 18 summarizes the results of the BCA for the Greenway Project.

Table 18: Benefit Cost Analysis RBD-Living with the Bay Greenway Project

	Category	Cumulative Present Value (Constant 2018 US Dollars)
	LIFECYCLE COSTS	**(2019-2069)**
	Project Investment Costs	$9,976,107
	O&M	$3,308,615
[1]	**Total Costs**	$13,284,722
	BENEFITS	
[2]	Resiliency Values	$2,579,187
[3]	Environmental Values	$31,033,290
[4]	Social Values	$18,496,193
[5]	Economic Revitalization Benefits	$38,159,610
[6]	**Total Benefits**	**$90,268,279**
[7]	**Measures of Project Merit:**	
	Benefits less Costs [Net Present Value (Net Benefits @ 7%)]	$76,983,557
	BCR	6.79
	RBD LWTB Rate of Return	164.8%

	Category	Cumulative Present Value (Constant 2018 US Dollars)

\a Costs represent the discounted present value of the nominal projected costs (over 2020-2021). Therefore, they will appear smaller than the nominal costs due to the application of the 7% HUD-recommended discount rate.

Measures of Project Merit: Greenway Project

- The Greenway Project is economically feasible and has a positive BCR of 6.79. Benefits are five times larger than the cumulative present value of lifecycle costs.
- The cumulative net present value (benefits less costs) is $76,983,557 million. A project with a positive net present value is an economically viable public project that will add value to the community.
- For a project to be economically feasible, the IRR must exceed the discount rate. The RBD LWTB rate of return of 165 percent exceeds the HUD-recommended project discount rate of 7.0 percent.

Figure 10 below shows a breakdown of the benefits of the Greenway Project.

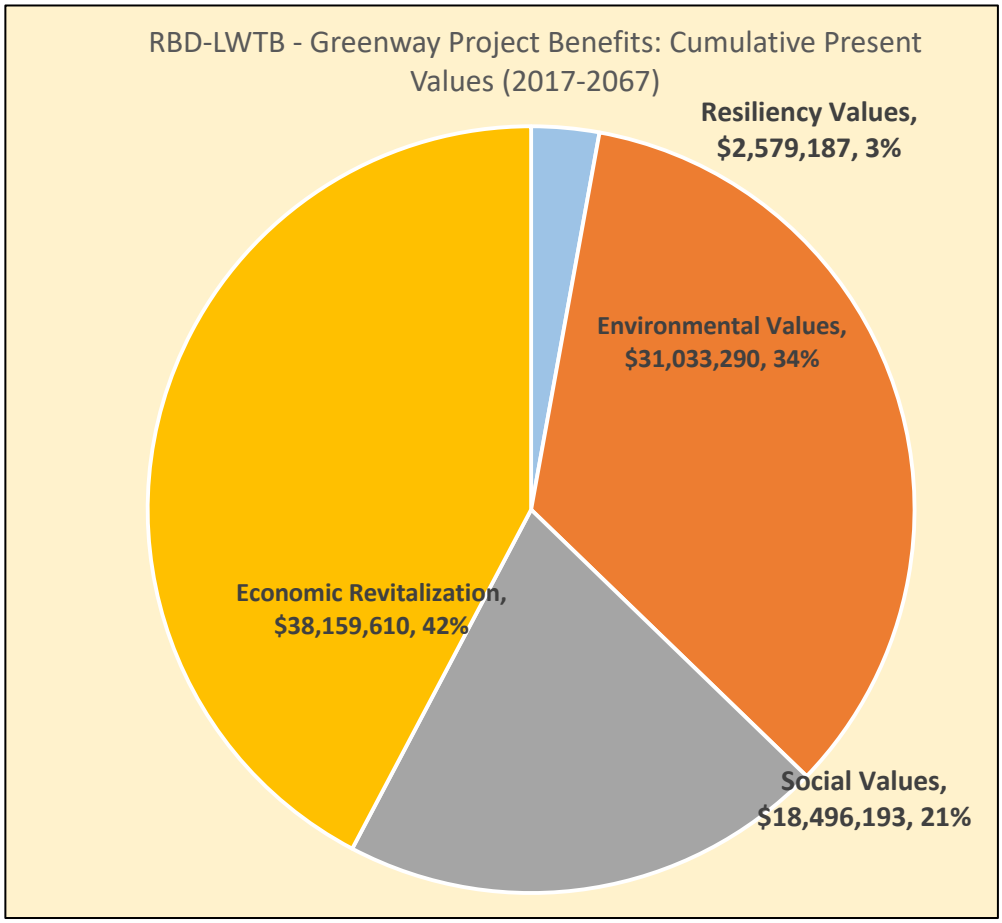


Figure 10: Benefits of Greenway Project

7.5 Lister Park

Project Objectives: The objective of the project is to provide flood protection to the surrounding LWTB community, enhance waterfront access, mitigate shoreline erosion, enhance habitat, and provide recreational and pedestrian connectivity along the existing pathways of the Mill River waterfront. The project would help to restore the environmental health and water quality of Mill River, south of Smith Pond. Planting native vegetation would result in a net benefit on wetland function and values (TetraTech, 2019).

Project Description: The project site is primarily residential and includes the existing Village of East Rockaway Department of Public Works storage yard and several public parks (Bligh Field, Centennial Field, Lister Park, and Tighe Field). The project would consist of the following elements:

- Installing 3,730 linear feet of Living Shoreline to provide bank stabilization, prevent erosion, and enhance habitat along Mill River
- Constructing a bioretention basin at Tighe Park to increase stormwater quality and retention prior to runoff release to the Mill River
- Reconstructing and repaving the existing parking lot and bioretention basin at centennial field to prevent ponding of water in the parking lot and to increase stormwater quality prior to runoff release to the Mill River
- Replacing the overlook at Bligh Park to provide visual access to the waterfront.
- Constructing an earthen berm and knee walls at Bligh Field to provide flood protection to homes located on Riverside Road

7.5.1 Lifecycle Costs

Lifecycle costs consist of both capital construction costs and the long-term annually recurring O&M costs that would be required to maintain the Lister Park assets and improvements. **Table 19** shows a breakdown of the main capital costs by project component.

Table 19: Lister State Park Project Capital Costs by Main Project Element

Project Element	Cost
Lister Park Project Lump Sum (Excluding Greenway)	$1,616,000
Contract Allowances & Unit Prices (Allow 2% of Lump Sum)	$32,320
Lister Park Total Construction Cost	$1,648,320
Design Contingency (15% of Construction Cost)	$247,248
Design, Survey & Permitting (20% of Construction Cost)	$329,664
Construction Management Fee (10% of Construction Cost)	$164,832
Lister Park Total Project Cost	**$2,390,064**

Source: Nasco Construction, 2018

The Lister Park Project is expected to cost approximately $2.4 million. The Centennial Park Drainage Improvements and Riverside Drive Flood Protection components represent about half the project's capital costs. Contingency, design, permitting, and construction fees represent about one-third of the project's budget. Note that the Mill River Greenway would also be extended through the Lister Park area, but this improvement (including costs) analyzed in the separate *Greenway* section of this BCA. Annual O&M costs of $71,702 were assessed based on an assumption that O&M would be about 3 percent of the capital costs of the project and would consist of inspecting and maintaining check valves, maintaining the floodbreak panels at Bligh Field, and mowing and maintaining vegetation associated with the bioswales at Tighe and Centennial Parks. This O&M percentage is consistent with other projects in this analysis, such as HLSP.

7.5.2 Resiliency Values

The installation of knee walls, a floodbreak barrier, and a berm at Bligh Field would permanently protect several homes along Riverside Drive that are currently located in Zone AE, a 100-year floodplain. Analysts used FEMA's BCA Toolkit Version 5.3.0 Flood Module to estimate the benefits of protecting these homes from flooding. Flood protection would result in annual avoided damages of $13,489 to buildings and $10,262 to building contents, resulting in a beneficial impact to the local community that has a cumulative present value of $284,839. The analysis is based on the FEMA Flood Insurance Study for Nassau County, the County Assessor Database from the Nassau County Department of Assessment, and Google Earth (FEMA BCA Toolkit, n.d., Google Earth, 2019; Nassau County Department of Assessment, 2019b).

Regular storm drain inspection and cleaning would contribute to maintaining adequate drainage in the stormwater system to manage stormwater runoff and maintain the resiliency and capacity of the stormwater system. These benefits are not quantified but would be a + (positive impact) and contribute to the overall resiliency of the quantified elements here. The benefits of the installation of backflow preventers are also not quantified. However, backflow preventers would serve to support the function of the flood protection benefits and bioswale functions by preventing flood waters from Mill Creek entering the stormwater system and flooding these assets.

The cumulative present value of the resiliency value over the project evaluation period was estimated to be **$284,839.**

7.5.3 Social Value

Installation of the Riverside Drive flood protection elements would result in an improved living environment for those residing in homes along Riverside Drive. The value of this benefit is quantified above under *Resiliency Values*. Additionally, the recreational value of the assets at Lister Park would likely increase as a result of the improvements to vegetation and trail resources at the park. The resiliency and environmental values of these changes are described elsewhere but there would also be a + (positive impact) to social value as a result of the construction of these projects.

7.5.4 Environmental Value

The primary driver of environmental values associated with the Lister Park Project would include permeable infrastructure project elements (e.g., bioswales and trees). They contribute to stormwater flood risk mitigation and attenuation of stormwater nuisance flooding events by improving the

remnants of the Mill River floodplain within an urban setting. Allowing stormwater to infiltrate and be absorbed back into the ground can reduce stormwater contributions to runoff and high velocity poor water quality contributions to the Mill River and downstream catchment areas. The environmental values of these permeable assets were quantified by applying the Green Infrastructure calculator (CNT and American Rivers, 2010). The calculator quantified the gallons of stormwater runoff that would be absorbed and filtered by the bioswales and trees allocated to this project. The calculator also quantified the pounds of criteria air pollutants that would be removed by trees and vegetation, the pounds of carbon dioxide that would be sequestered, and any energy savings. Unit values per pound of pollutant removed and per gallon of stormwater runoff reduced were also applied.

Some trees would be removed as part of the project, but overall there would be a net gain of 276 small trees and shrubs. Additionally, 4,590 square feet of new bioswale would be constructed at Tighe and Centennial Parks. The cumulative present value of the net gain in trees and bioswale on this project would be $1.9 million (Amy S. Green Environmental Consultants 2019).

The largest resiliency value is associated with the permeable pavement installed at the parking lot on Bligh Field. Permeable pavement can reduce stormwater contributions to runoff and high velocity poor water quality contributions to the Mill River. The resiliency and environmental values quantified for the Bligh Field parking lot were estimated by applying the Green Infrastructure calculator (CNT and American Rivers, 2010). The calculator quantified the gallons of stormwater runoff that would be absorbed and filtered by the urban greenspace allocated to the greenway. The calculator also quantified the pounds of criteria air pollutants that would be removed by trees and vegetation, the pounds of carbon dioxide that would be sequestered, and energy savings. Unit values, per pound of pollutant removed and per gallon of stormwater runoff reduced were also applied. It is assumed that approximately 15,900 square feet of permeable pavement would be constructed at Bligh Field, with a cumulative present value of $1,101,873.

Additional environmental values associated with Lister Park were assessed based on the number of acres of improved wetland and corresponding water quality associated with the installation of the living shoreline bank stabilization project element. The annual average benefit per acre of preserved water quality was applied to the net increase in wetland habitat of 0.588 acre. A benefits-transfer approach was applied to value the 0.588 acre of incremental quality to the Mill River by applying the national annual average benefit values per acre for individual ecosystem services per year produced by wetlands mitigation required under Section 404 of the Clean Water Act (Adusumilli, 2015). Because wetlands are being created, the entirety of the per-acre benefit was applied.

The cumulative present value of the annual green infrastructure benefit from ecosystem services of living shorelines, improved water quality in the Mill River, the bioretention ponds, trees, and permeable pavement would be equal to **$3,241,097** over the 50-year project evaluation period.

7.5.5 Economic Revitalization

Property values may increase, especially along Riverside Drive, from the increased flood protection that this project would provide. Daniel, Florax, and Rietveld (2009) performed a meta-analysis of the implicit price of flood risk and found that an increase in the probability of flood risk of 0.01 in a year is associated with a decrease in transaction price of -0.6 percent. Upon installation of Riverside Drive Flood

Protection, property values for 10 parcels with a current market value of $7.3 million would be protected from 100-year flood events. The cumulative present value of this benefit is equal to **$35,999**.

7.5.6 Benefit Cost Analysis Results

Table 20 summarizes the results of the BCA for the Lister Park Project.

Table 20: Benefit Cost Analysis RBD-Living with the Bay Lister Park Project

	Category	Cumulative Present Value (Constant 2018$)
	LIFECYCLE COSTS	**(2019–2069)**
	Project Investment Costs	$2,160,639
	O&M	$859,901
[1]	**Total Costs**	$3,020,541
	BENEFITS	
[2]	Resiliency Values	$284,839
	Avoided Annual Damage to Structures	$284,839
[3]	Environmental Values	$3,241,097
	Ecosystem services Value of Living Shorelines	$167,131
	Value of Improved Water Quality in Mill River	$64,245
	Bioretention ponds at Tighe and Centennial Fields Contribution	$1,494,244
	Permeable pavement contribution	$1,101,873
	Trees Contribution	$413,604
[4]	Economic Revitalization Benefits	$35,999
	Property Values	$35,999
[5]	**Total Benefits**	**$3,561,935**
[6]	**Measures of Project Merit:**	
	Benefits less Costs [Net Present Value (Net Benefits @ 7%)]	$541,395
	BCR	1.18
	RBD Rate of Return	8.9%

Measures of RBD Project Merit

- The Lister Park Project is economically feasible and has a positive benefit cost ratio of 1.18. Benefits are equal to the cumulative present value of lifecycle costs.
- The cumulative net present value (benefits less costs) is $541,395. A project with a positive net present value is an economically viable public project that will add value to the community.

- For a project to be economically feasible, the IRR must exceed the discount rate. The RBD rate of return of 8.9 percent exceeds the HUD-recommended project discount rate of 7.0 percent.

Figure 11 shows a breakdown of the benefits of the Lister Park Project.

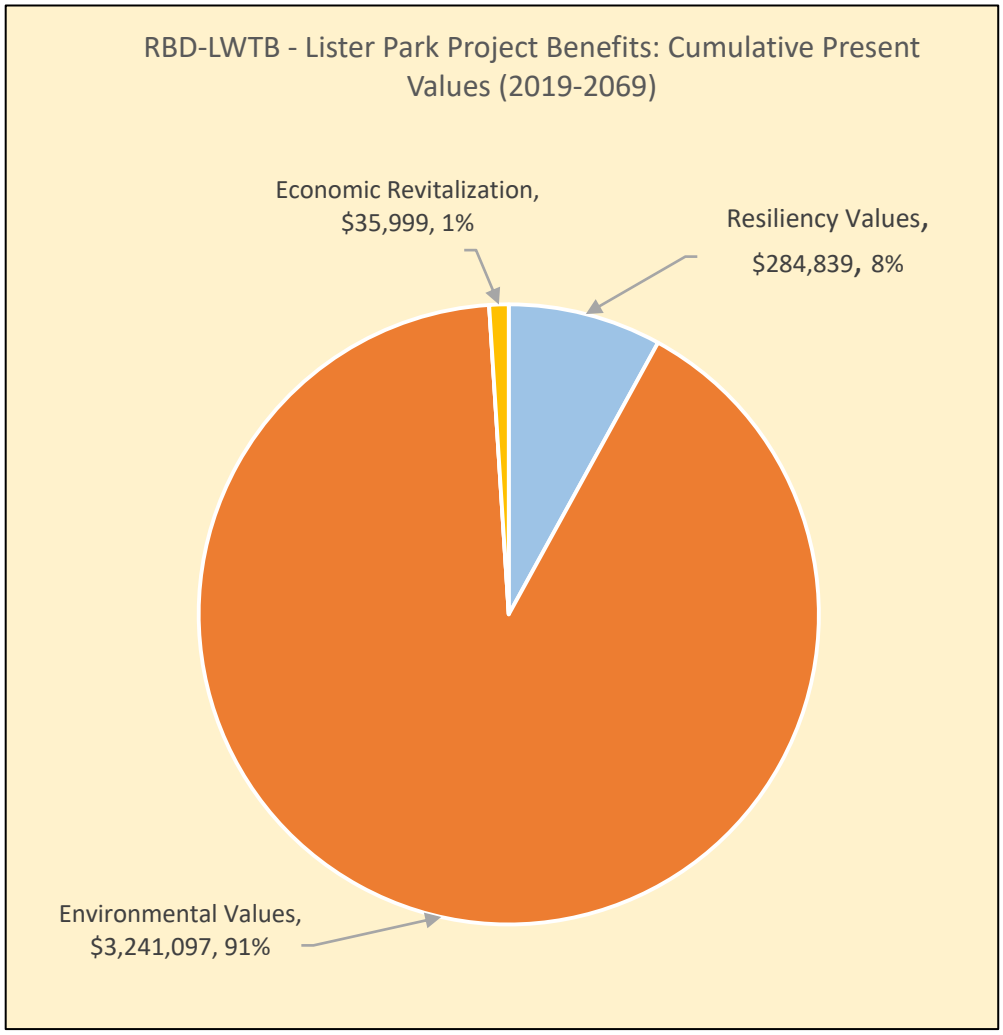


Figure 11: Breakdown of the Benefits of the Lister Park Project

7.6 Education Programs

Project Objectives: The objective of this project is to strengthen the social infrastructure of communities within the LWTB project area through social service programs that align with the goals of the LWTB Project. To achieve this objective, GOSR would work with relevant community organizations and/or educational institutions to develop public education programs and provide job training. The education programs would include environmental and historical education for schools and the public; job training programs would focus on green infrastructure (GOSR, 2019b). GOSR has further defined these objectives below (GOSR, 2019c):

1. Provide environmental stewardship opportunities to (pre) K–12 students, higher education students, and other members of the community through:

a. Education about resiliency topics relevant to the LWTB project area. Possible options include, but are not limited to, stormwater interventions included in the LWTB design; environmental awareness; wildlife conservation and ecology; watershed history; STEM/STEAM education and teacher training; on-site and hands-on education and teacher training; affordable housing; and economic impacts of natural disasters

b. Environmental Education and Resiliency Center (as discussed in the *Hempstead Lake State Park* section in this BCA)

c. Community service that complements the educational resiliency topics

d. Monitoring, research, and data collection that allows students to engage in research projects pertaining to LWTB and monitors long-term effects of the interventions

2. Develop a workforce training vocational curriculum for high school students, high school graduates, and/or unemployed/under-employed residents seeking to gain skills in construction. Graduates of the program are eligible to continue to work on and support the LWTB project as helpers on site as part of Hofstra's externship program.

Project Description: The project site includes the entirety of the LWTB project area, from the Town of Hempstead in the north to Hempstead Bay in the south. The project would consist of two programs that would be run by Hofstra and Seatuck, as described below:

Hofstra, through its Public Awareness and Education and Workforce Development Program, would undertake the following work (Hofstra, 2019):

- Mentor students from eight "high needs" high schools in the area around the LWTB project area to develop research projects within the Mill River Watershed.
- Develop an environmental sustainability certificate program for local government policy makers, staff, and project workers.
- Research and write signage to educate the public on the objective of the LWTB Project and their natural and cultural history contexts.
- Develop a curriculum for (pre) K–12 students to examine the role of water in the world, explore how weather and climate change interact, discover how natural hazards occur, and study the human impact on Earth's natural processes and ecological systems.
- Host a collaborative academic research program to complement other project components to provide a centralized program the for interaction between Hofstra faculty and staff and community members participating in other project components.
- Develop and execute a community outreach and public awareness education campaign to encourage stewardship among the residents of the Mill River and Bay Watersheds.
- Work with the Nassau Boards of Cooperative Education Services to implement a workforce development program to provide students with the foundation required to work in areas of heavy construction and operation of heavy machinery.
- Work with undergraduate students and high school volunteers to script, shoot, edit, and produce annual video documentaries updating the public on LWTB.

Seatuck Environmental Association Ecological Advisory Services would undertake the following work (Seatuck, 2016):

- Generate a partial baseline report on the Mill River's ecological health through a series of surveys and monitoring projects.
- Develop environmental education programming related to the restoration and resiliency of the Mill River.
- Develop a lecture and field trip series about the natural and human history of the river, the river's ecology, and the status of restoration efforts.
- Develop 18 seasonal general public programs involving the restoration and resiliency efforts and access points contemplated in the LWTB Projects.

(The costs and benefits of the proposed Hempstead Lake State Park Environmental Education and Resiliency Center are addressed in the *Hempstead Lake State Park* section of this BCA.)

7.6.1 Lifecycle Costs

Lifecycle costs consist of the costs to run both the Hofstra and Seatuck programs. Hofstra programs are assumed to run over a 4-year period, while Seatuck programs are assumed to run over a 2-year period based on the cost estimates provided for these projects (Hofstra University, 2019; Seatuck, 2016, 2017). **Table 21** breaks down the individual program components by provider.

Table 21: Education Programs Project Capital Costs by Main Project Element

Description	Total	Percent of Total
Hofstra University Public Awareness and Education and Workforce Development Program	**$1,064,718**	**94%**
High School Engagement through Summer Science Research	$240,000	21%
Environmental Sustainability Certificate Program	$86,280	8%
Public Education via Signage	$79,560	7%
Workforce Development	$139,950	12%
Video Production	$7,500	1%
Living and Learning with the Bay Program Administration	$511,428	45%
Seatuck Environmental Association Ecological Advisory Services	**$77,656**	**7%**
Ecological Advisory Services	$37,730	3%
Environmental Education Programs	$39,926	3%
Total	**$1,137,374**	**100%**

Sources: Hofstra, 2019; Seatuck, 2016, 2017, 2019
*Note that percentages may not total 100 due to rounding.

The Hofstra Public Awareness and Education and Workforce Development Program and Seatuck Environmental Association Ecological Advisory Services programs are expected to cost approximately $1.14 million over a period of 4 years. The administrative costs of operating Hofstra's program represent nearly half the total project cost. However, these costs support portions of all the other program components. Hofstra would be responsible for most of the educational programming work under this project, with 94 percent of the project's budget. No capital or O&M costs identified for these programs. Instead, costs in **Table 21** are considered program operating costs; therefore, no contingency or management fees are provided.

7.6.2 Resiliency Values

The education programs are not expected to directly contribute to changes in resiliency values. However, it is possible that there would be some indirect, positive impact on regional resiliency values. The programs would increase the knowledge of community members and decision makers who then would reasonably be expected to make better-informed decisions that may lead to increased resiliency of human and ecological systems. Resiliency value impacts are therefore listed as + (positive impact) for the Education Programs Project.

7.6.3 Social Value

The primary driver of social values is the development and installation of signage for parks and public spaces that would educate the public about the area's natural history, human history, groundwater and surface water interactions, coastal connections, ecosystems, climate change, green infrastructure and Hurricane Sandy. A 2002 article published in the *Journal of Ecotourism* found that installation of trail-side signage resulted in a significant increase in the number of visitors reporting a fulfilling learning experience to a recreational site (Hughes and Morrison-Saunders, 2002). If visitors to sites within the LWTB project area receive a 1 percent increase in recreational values per visit as a result of increased signage, the impact on the cumulative present value of recreational visits to the LWTB project area could be large. If this 1 percent increase were applied to half of the visitors to HLSP in 2016, it would represent a cumulative present value of $1,192,618, at a value of $57.90 per visit as described in the HLSP analysis above. This value is conservative given that (1) the total number of visitors to the LWTB project area is greater than just those visiting HLSP, and (2) it is assumed that only half of visitors notice the signs and then gain only a 1 percent increase in recreational value by reading them. This shows that while marginally the increase in recreational value from additional signage per visitor is small, development of signs under Hofstra's program could have an outsized impact on overall visitor recreational values relative to other program components.

Hofstra would assist in the development of curriculum for grades (pre) K–12, and educators would be invited to a summer curriculum development workshop with continued support throughout the school year provided through a mentorship model. Lesson plans and documentation of professional development would be provided on a project website. Providing educators with professional development and the opportunity to craft a curriculum for their students is valuable (Teaching Tolerance, 2019). It is anticipated that this value, while not quantified here, would result in a + (positive impact) to social values in the community.

Students from eight “high needs” high schools in junior- and senior-level science courses would be recruited to assist in the development of ongoing research projects by Hofstra faculty. These students would be enrolled in the Hofstra University Summer Science Research Program and work on four-person research teams in the field and on the Hofstra campus for 5 weeks during each summer over a 4-year period. These summer sessions would culminate in a public research poster presentation. Hofstra would try to recruit 24 students annually from “high needs” schools with significant low-income and minority student populations to increase interest and participation in STEM careers by underrepresented students (Hofstra University, 2019). Each of these students is assumed to visit the project site at least five times during their research programs at a value of $57.90 per visit, resulting in a cumulative present value of $25,181 for Hofstra’s High School Engagement through Summer Science Research program.

Hofstra would implement a workforce development program to increase the social resiliency of participants in other education program components. This program would provide students the skills necessary to work in areas of heavy construction and around operation of heavy machinery. This 33-week program would allow students to be able to continue to work and support the LWTB projects as on-site assistants as part of a Hofstra externship. A study performed by the W.E. Upjohn Institute for Employment Research estimated the net impacts and private and social benefits and costs of 12 workforce development programs in Washington State. Two of these net impact estimates included an estimate of the net return on costs of Workforce Investment Act Youth programs and Community and Technical College Workforce Education programs. The annual public return on investment of these programs was between 4.8 and 12.8 percent, respectively (Hollenbeck and Huang, 2016). Conservatively assuming that the $139,950 in spending on workforce development programs would return 4.8 percent annually results in a cumulative present value of $99,425 for Hofstra’s workforce development program.

Hofstra would engage in community outreach and a public awareness campaign to encourage stewardship of the Mill River, its watershed, and Hempstead Bay. This program would include a series of public education events, guided tours, and citizen scientist projects to develop a sense of confidence among members of the community in the LWTB project and building a feeling of loyalty and commitment to the program among community residents. Activities may include guided walks through the watershed, kayak tours through coastal marshes, and community informational events using presentations focusing on environmental awareness issues. Additionally, Seatuck would develop a lecture and field trip series that could include birding trips to HLSP, botany and insect walks, or a seining program. These field trips would directly lead to additional visitor trips to places like HLSP or other parks or aquatic areas in the LWTB project area. It was assumed that at least 10 participants would attend these trips once per month annually, resulting in 120 additional annual visits over a period of 2 years (the length of the Seatuck contract). An average value per visit of $57.90 was applied per the methodology described in the HLSP section, resulting in a cumulative present value of $13,441 in benefits.

The cumulative present value of the signage, high school engagement, workforce development, and environmental education programs would be **$1,330,666** over the 50-year project evaluation period.

7.6.4 Environmental Value

No direct quantifiable environmental value benefits are identified in this project. However, numerous positive indirect environmental value impacts are likely to result from the various educational,

workforce development, and community engagement programs developed under this project. For example, student research projects, including monitoring water quality of stormwater runoff, measuring flooding and correlating with storm intensity and rainfall volume, monitoring the ecological health of engineered wetlands, and assessing public satisfaction with infrastructure improvements, could ultimately lead to changes in policies or development of green infrastructure projects that ultimately improve ecosystem function or quality.

The environmental sustainability certificate program undertaken as part of this project would provide an opportunity for local government policy makers, staff, and project workers to increase their knowledge of environmental quality, environmental management, suburban sustainability, and water science through a series of 9 monthly 3-hour classes. It is assumed that those who attend certification and training programs would exit the programs with a better understanding of the need to protect the local environment and be equipped with the necessary information and tools to do so, ultimately having a + (positive impact) on environmental values. Additionally, development of an ecological baseline report of the Mill River would help provide clarity on how best to spend limited dollars to enable the greatest environmental value in future work.

The development of a program called "A Day in the Life of the Mill River" would both educate program participants on the river's beauty, history, and ecological significance and provide the public and policy makers with annual snapshots of the river's health. This program would not only engage students from local schools but would provide a time-series set of information that shows policy makers how well ecosystem restoration and stormwater quality projects are functioning. Policy makers could use this information to better design future environmental projects as necessary.

While no direct quantifiable environmental value benefits would result from the education programs, it is likely that there would ultimately be + (positive impact) environmental value impacts as a result of the Education Programs Project.

7.6.5 Economic Revitalization

The education programs would have no direct impact on economic revitalization in the project area. Increased signage, education programs, and public education about improvements in area parks and waterways may have an indirect, positive impact on home values or tourism revenue in the area, but ultimately these impacts are ? (impact unknown) for economic revitalization as a result of the Education Programs Project.

7.6.6 Benefit Cost Analysis Results

Table 22 summarizes the results of the BCA for the Education Programs Project.

Table 22: Benefit Cost Analysis RBD-Living with the Bay Education Programs Project

	Category	Cumulative Present Value (Constant 2018$)
	LIFECYCLE COSTS	**(2019–2069)**
	Hofstra Education Programs	$964,719

	Category	Cumulative Present Value (Constant 2018$)
	Seatuck Education Programs	$75,115
[1]	**Total Costs**	$1,039,834
	BENEFITS	
[2]	Resiliency Values	+
[3]	Social Values	$1,330,666
	Public Tours and Field Trips	$13,441
	Public High School Engagement Programs	$25,181
	Public Signage and Awareness	$1,192,618
	Workforce Development Program	$99,425
[4]	Environmental Values	+
[5]	Economic Revitalization Benefits	?
[6]	**Total Benefits**	**$1,330,666**
[7]	**Measures of Project Merit:**	
	Benefits Less Costs [Net Present Value (Net Benefits @ 7%)]	$290,832
	BCR	1.28
	RBD Rate of Return	9.2%

Measures of RBD Project Merit

- The Education Programs Project is economically feasible and has a positive BCR of 1.28. Benefits are greater than the cumulative present value of lifecycle costs.
- The cumulative net present value (benefits less costs) is $290,832. A project with a positive net present value is an economically viable public project that will add value to the community.
- For a project to be economically feasible, the IRR must exceed the discount rate. The RBD rate of return of 9.2 percent exceeds the HUD-recommended project discount rate of 7.0 percent.

7.7 East West Boulevards

Project Objectives: During large storm events, water from Hempstead Bay can back up into the stormwater system and cause flooding along East and West Boulevards. Flooding can occur during non-storm events because of high tides or during storm events when high tides fill the stormwater system and prevent the evacuation of stormwater from the project area. The project would prevent tidal waters from entering the stormwater system but allow stormwater to exit the system during low tides. The project would also install bioswales and porous pavement to treat stormwater before it enters the bay, thereby improving water quality in the bay.

Project Description: The project site is primarily residential and includes residences that are located along or adjacent to East and West Boulevards in East Rockaway, New York. The project would consist of the following elements that would reduce stormwater and tidal inundation impacts on the project site:

- Installing porous asphalt shoulder on both sides of the roadway with new stone reservoirs under the roadway pavement
- Replacing catch basins at each stormwater outfall to capture debris and sediment prior to stormwater release to the bay
- Installing or replacing existing backflow preventers at 13 stormwater outfalls to prevent tidal inundation of the stormwater system
- Installing two bioswales to increase stormwater quality prior to runoff release to the bay

7.7.1 Lifecycle Costs

Lifecycle costs consist of both capital construction costs and the long-term annually recurring O&M costs that would be required to maintain the East West Boulevard assets and improvements. Capital costs were not broken out into specific project elements and are therefore not broken out here. Capital costs total $3,196,649 million plus a 20 percent contingency fee of $639,329.88. The total cost to construct the project was estimated to be $3,835,979 (Cashin Associates, 2019a).

Annual O&M costs include $6,700/year to maintain the check valves, which includes the cost of a vacuum truck rental and two laborers plus dumping fees; $5,500/year to maintain the porous asphalt, which includes the cost of an asphalt vacuum truck and operator for one day a year plus dumping fees; and $16,250/year to maintain the bioswale, based on the cost of a riding mower with an operator and a landscaper once per month to maintain vegetation (Cashin Associates, 2019b). These fees total $28,450 per year in annual O&M costs and have a cumulative present value of $341,193.

7.7.2 Resiliency Values

The primary resiliency values associated with the East West Boulevards Project are based on avoided vehicle trip delays associated with a reduction in monthly flooding of roadways in the project area. Permeable pavement values and their contribution to stormwater flood risk mitigation and attenuation of stormwater nuisance flooding events provide a second source of resiliency value by increasing the amount of runoff that roadways in the project area can absorb during a storm event. As described for the other projects above, allowing stormwater to infiltrate and be absorbed back into the ground can reduce stormwater contributions to runoff and reduce high-velocity, poor water quality contributions to Hempstead Bay. Installation of backflow preventers within the stormwater system would reduce street level flooding in the event of a high tide or during a storm event. These backflow preventers would also allow the remaining project elements (bioretention basins, permeable pavement, and vegetated areas) to be more effective at capture and storage of stormwater, which would further mitigate potential stormwater impacts at the project site and adjacent properties. The backflow preventers would provide additional resiliency benefits during high tide by creating storage retention basins for stormwater to enter. As the tide recedes, accumulated stormwater will be released into the bay, facilitated by the conveyance and outfall system. Perforated pipes would also be installed under porous pavement and attached to the stormwater system to provide an additional avenue for water to exit the stormwater system during a storm event at high tide when backflow preventers are closed.

The resiliency values quantified for this project were estimated by applying the Green Infrastructure calculator (CNT and American Rivers, 2010). The calculator quantified the gallons of stormwater runoff that would be absorbed and filtered by the 8,848 square feet porous pavement allocated to this project (Cashin Associates, 2019c). The cumulative present value of the net gain in porous pavement for stormwater absorption is approximately $3.0 million.

Backflow preventers provide a + (positive impact) to overall resiliency as described above, by contributing to the overall reduction in roadway flooding. Reductions in flooding of East, West, and North Boulevards should allow these roads to become passable during moon and spring tides each month. Similar to the assessment undertaken at Smith Pond, an assessment of the value of lost time due to delays from roadway flooding was considered. It is assumed that current flooding of the roadways in the project area contributes up to 15 minutes of delays per vehicle trip twice per month for those travelling to and from East and West Boulevards. The combined impacts of the project elements should reduce roadway flooding and limit or eliminate these delays. Based on an annual average daily traffic volume of 539 at East Boulevard, it was assumed that East and West Boulevards have a combined annual average daily traffic volume of 1,078. The elimination of 15-minute delays twice a month for these trips would result in an annual elimination of 4.5 days of delay valued at $234,332 annually, for a cumulative present value of approximately $2.8 million.

In summary, the cumulative present value of the annual value of combined flooding mitigation and stormwater infiltration through porous pavement was estimated to be $5.8 million over the 50-year project evaluation horizon.

7.7.3 Social Value

Installation of the roadway flood protection and stormwater treatment elements of the project would improve the living environment for those residing in homes along or adjacent to East and West Boulevards. The value of this benefit is quantified as part of resiliency values, above. Additionally, some qualifiable increase in improved social values is likely to result from the improved living environment and reduced likelihood of contamination to those living in the neighborhood from environmental pathogens or chemicals that can collect from stagnant water. Therefore, the project would have a + (positive impact) on social values.

7.7.4 Environmental Value

The primary driver of environmental values associated with East West Boulevards project would be the permeable infrastructure project elements (e.g., bioswales and vegetated areas). These project elements would treat stormwater runoff by cleaning the stormwater before it enters the bay. Allowing stormwater to infiltrate and be absorbed back into the ground can also reduce stormwater contributions to runoff. The environmental values of these permeable assets were quantified by applying the Green Infrastructure calculator (CNT and American Rivers, 2010). The calculator quantified the gallons of stormwater runoff that would be absorbed and filtered by the bioswales and vegetated areas allocated for this project. The calculator also quantified the pounds of criteria air pollutants that would be removed by vegetation, the pounds of carbon dioxide that would be sequestered and any energy savings. Unit values per pound of pollutant removed and per gallon of stormwater runoff reduced were also applied. Based on current designs, 3,815 square feet of new bioswale would be

constructed (Cashin Associates, 2019a, c). The cumulative present value of the annual green infrastructure benefit from bioretention ponds would be equal to approximately $1.2 million over the 50-year project evaluation period.

7.7.5 Economic Revitalization

The decrease in monthly flooding of roadways that would result from the project elements may increase property values in the project area. This increase in value would have a positive effect on current residents because potential future buyers of their properties would be able to factor the decrease in regular flooding of the area's roadways into the perceived value of these homes during a future purchase. Additionally, properties around the bioretention ponds may experience an incremental increase in value as a result of a slight increase in natural beauty of the environment around these properties that the bioretention ponds provide. Overall, these benefits would result in a + (positive impact) in terms of economic revitalization in the community.

7.7.6 Benefit Cost Analysis Results

Table 23 summarizes the results of the BCA for the East West Boulevards Project.

Table 23: Benefit Cost Analysis RBD-Living with the Bay East West Boulevards Park Project

	Category	Cumulative Present Value (Constant 2018$)
	LIFECYCLE COSTS	**(2019–2069)**
	Project Investment Costs	$3,467,760
	O&M	$341,193
[1]	**Total Costs**	$3,808,953
	BENEFITS	
[2]	Resiliency Values	$5,780,486
	Porous Pavement	$2,970,203
	Value of Avoided Traffic Delays for Roads	$2,810,283
[3]	Environmental Values (Bioretention Ponds)	$1,242,064
[4]	Social Values	+
[5]	Economic Revitalization Benefits	+
[6]	**Total Benefits**	**$7,022,550**
[7]	**Measures of Project Merit:**	
	Benefits Less Costs [Net Present Value (Net Benefits @ 7%)]	$3,213,597
	BCR	1.84
	RBD Rate of Return	13.6%

Measures of RBD Project Merit

- The East West Boulevards Project is economically feasible and has a positive BCR of 1.84. Benefits are almost two times the cumulative present value of lifecycle costs.
- The cumulative net present value (benefits less costs) is $3,213,597. A project with a positive net present value is an economically viable public project that will add value to the community.
- For a project to be economically feasible, the IRR must exceed the discount rate. The RBD rate of return of 13.6 percent exceeds the HUD-recommended project discount rate of 7.0 percent.

Figure 12 shows a breakdown of the benefits of the East West Boulevards Project.

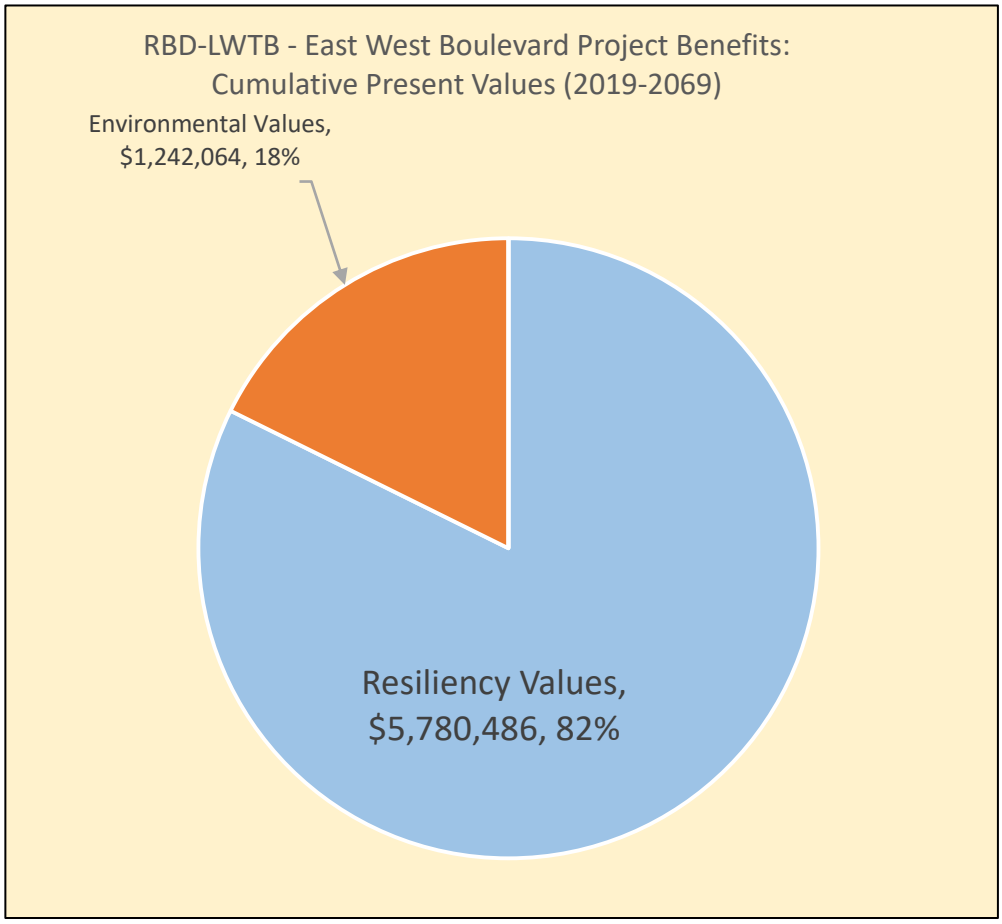


Figure 12: Breakdown of the Benefits of the East West Boulevards Project

7.8 Long Beach Water Pollution Control Plant

Project Objectives: Built in 1951, the Long Beach WPCP (the plant) is a secondary treatment facility (via trickling filter, final clarifiers, sand filters and hypochlorite disinfection) serviced by 51 miles of collection system pipeline and three pump stations. The plant has a permitted design flow of 7.5-million-gallons-per-day (MGD), with the average from the 5 years recorded at 4.63 MGD. The plant services the City of Long Beach, Lido Beach, and Point Lookout, with estimated populations in 2017 of 33,657, 3,073, and 1,093, respectively (US Census, 2018a, 2018b). To the north, the plant is bordered by Reynolds Channel, part of Western Bays. Effluent from the plant discharges into Reynolds Channel, which is included on the

Clean Water Act Section 303(d) list of Impaired Waters. The aging plant requires repairs to remain in service. In addition, to comply with the plant's State Pollution Discharge Elimination System Permit, it must also enhance treatment processes to achieve reductions in ammonia, nitrogen, and total residual chlorine (Hazen Arcadis, 2019a). The project objective is to improve the plant's resiliency and improve water quality.

Project Description: The Long Beach WPCP Consolidation Project would eliminate the antiquated Long Beach WPCP and its discharge into Reynolds Channel. Sewage from the Long Beach barrier island would be conveyed via a storm-resilient pumping facility to the newly upgraded and storm-hardened Bay Park STP located in the Hamlet of Bay Park adjacent to the mouth of Mill River. The Bay Park STP has excess treatment capacity and is in the final phases of a recovery and resilience initiative. This project is intended to strengthen the resilience of the wastewater treatment infrastructure against future storm events and improve water quality through improved wastewater treatment to better serve the communities of the City of Long Beach, Lido Beach, and Point Lookout. The following elements are included in the project:

- Constructing a new 24-inch force main connection from the Long Beach WPCP to the Bay Park STP to convey untreated sewage
- Converting the existing influent pump building at the Long Beach WPCP into a new flow diversion pump station
- Hardening the new flow diversion pump station to protect it from future storm events and sea level rise

The existing plant would remain in service during construction of improvements to the existing building, installation of new pumping units, replacement of the current screening equipment with grinders, and the installation of a 24-inch diameter force main pipe from the existing influent pumping area at Long Beach to an existing sanitary sewer main at Bay Park STP.

The Long Beach WPCP Consolidation Project is one component of the Western Bays Resiliency Initiative. Another component of the initiative is the Bay Park Conveyance Project, which includes diverting treated effluent from the Bay Park STP to the Cedar Creek WPCP, where it would be discharged into the Atlantic Ocean via an existing outfall structure. The completion of the Bay Park Conveyance Project, expected in 2025, is expected to significantly improve the water quality in Western Bays. This benefit is not quantified for the purposes of this project.

7.8.1 Lifecycle Costs

Lifecycle costs for the project were estimated based on preliminary estimates from the Arcadis design team and the *Long Beach WPCP Consolidation Project – Design Feasibility Memorandum* dated May 14, 2019, as well as cost estimates prepared during the design process from March 2020 (Hazen Arcadis, 2019a, b; 2020; Nassau County DPW, 2020). For the purposes of this BCA, costs of about $88 million were assumed to be spent during a construction period from 2020 to 2022. (This provides a conservative analysis; if costs were spread over later years, the project BCR would be higher than reported here.) O&M costs for the pumping station were assumed to be consistent with other pump stations in the area; for the purposes of this analysis, the project team used an annual cost of approximately $20,000. These O&M costs are included here to conservatively represent a possible increase in cost as a result of the project; however, it is possible that net O&M costs would actually

decrease as a result of increased economies with the new project. This estimate reflects the total project cost, including all funding sources, and represents a conceptual estimate of the cost of converting the influent pump building into a new flow diversion pump station and constructing the 24-inch force main. However, these costs do not reflect a detailed design and, therefore, do not represent detailed cost estimates of any of the proposed routes for the force main connection. Environmental impacts, scheduling constraints, permitting requirements (such mitigation of impacts), and seasonal impacts may influence this estimate.

7.8.2 Resiliency Values

Resiliency values for the Long Beach WPCP Project are largely focused on avoided damages to the Long Beach WPCP and emergency repairs and reduced vulnerability to large-scale outages.

Avoided Damages to Structure and Emergency Repairs

During Hurricane Sandy, the Long Beach WPCP required a significant investment of approximately $5,390,334 (2014 dollars) to repair or replace in-kind to pre-Sandy conditions for mechanical, electrical, plumbing, architectural, and structural damage. Additionally, Category B emergency repair costs at the Long Beach WPCP were approximately $154,409 (Hazen Arcadis, 2014). An on-site vulnerability assessment was prepared by Arcadis based on the vulnerability of individual plant assets at Long Beach WPCP to still water and sea level rise, consistent with both recent guidance by the New York City Panel on Climate Change 2019 Report on Sea Level Rise and FEMA guidance on incorporation of sea level rise in hazard mitigation programs (Gornitz et al., 2019; FEMA, 2016a). Based on this assessment, the Long Beach WPCP has a 16.028% probability of similar flood-related damages and emergency repairs in any given year. Given this likelihood and known repair costs, the estimated cumulative present value of avoided damages is equal to $10,676,383 in 2018 dollars.

Reduction of Vulnerability to Large-scale Outages

Following Hurricane Sandy, the City of Long Beach, and the neighboring communities Lido Beach and Point Lookout (populations of 33,657,3,073, and 1,093, respectively) lost wastewater services for approximately 12 hours. Furthermore, **Table 24** below illustrates FEMA's estimated impact by economic sector on a per capita basis (FEMA, 2016b). In 2018 dollars, this value was equal to approximately $65.34 per capita. This value was used to calculate the value of all loss of service as a result of Hurricane Sandy. However, Long Beach WPCP's sand filter was damaged during the storm and required costly electrical repairs to be returned to service. Over time, the loss of the sand filter negatively affected effluent quality at the plant and increased the suspended solids load in treated wastewater. In April 2014, the plant received a monthly permit violation for an elevated level of suspended solids.

To estimate the effect of this partial loss of service, 75 percent of the loss of wastewater service was assumed for a period of 30 days to account for the poor effluent quality directly attributable to the loss of secondary treatment services that had been provided by the damaged sand filter. Based on the updated Long Beach WPCP vulnerability to sea level rise and still water, the annual probability of this loss of service was assessed at 16.028%. For the population served by the Long Beach WPCP, the cumulative present value of this benefit was estimated to be equal to $101,819,978.

Table 24: Loss of Wastewater Service Impact to Economic Activity

Economic Sector	Wastewater Service Importance Factor	GDP 2017	GDP per Capita per Day (2018$)	Economic Impact per Capita per Day of Lost Service (2018$)
Agriculture, Livestock	n/a			
Mining	n/a			
Construction	0.2	(suppressed)	n/a	$4.23
Manufacturing - Nondurable Goods	0.65	$47,168,600,000	$6.51	$0.00
Manufacturing - Durable Goods	0.75	(suppressed)	n/a	$0.00
Transportation and Warehousing	0.1	(suppressed)	n/a	$1.73
Utilities and Transportation	0.2	$62,538,000,000	$8.64	$2.70
Wholesale Trade	0.2	$97,586,700,000	$13.48	$2.24
Retail Trade	0.2	$81,056,300,000	$11.20	$7.98
Real Estate, Rental, Leasing	0.2	$289,002,300,000	$39.92	$7.83
Finance and Insurance	0.2	$283,456,900,000	$39.15	$3.60
Information	0.2	$130,295,300,000	$18.00	$6.84
Professional, Scientific, & Technical Services	0.2	$247,790,900,000	$34.22	$15.74
Education, Healthcare, Social Assistance	0.8	$142,485,900,000	$19.68	$2.56
Arts, Entertainment, Recreation	0.8	$23,209,800,000	$3.21	$4.69
Accommodation & Food Service	0.8	$42,402,600,000	$5.86	$0.95
Other Services, Except Government	0.2	$34,558,900,000	$4.77	$4.23
Government	0.2	$153,290,200,000	$21.17	$4.23
TOTAL				$65.34
Calculated Annual Expected Damages				$9,110,241.44

7.8.3 Benefit Cost Analysis Results

Table 25 summarizes the results of the BCA for this project.

Table 25: Benefit Cost Analysis RBD-Living with the Bay Long Beach WPCP Project

	Category	Cumulative Present Value (Constant 2018 US$)
	LIFECYCLE COSTS	2019-2069
	Project Investment Costs	$77,177,636
	O&M	$273,832
[1]	Total Costs	$77,401,165
	BENEFITS	
[2]	Resiliency Values	$112,496,361
	Avoided Damages to Structure and Emergency Repairs	$10,676,383
	Reduction of Vulnerability to Large-Scale Outages	$101,819,978
[5]	Total Benefits	$112,496,361
[6]	Measures of Project Merit:	
	Benefits less Costs	$35,095,196
	BCR	1.45
	Internal Rate of Return	10%

Measures of RBD Project Merit

- The Long Beach WPCP Project is economically feasible and has a positive BCR of 1.45. Benefits are approximately 1.45 times the cumulative present value of lifecycle costs.
- The cumulative net present value (benefits less costs) is $35.1 million. A project with a positive net present value is an economically viable public project that will add value to the community.
- For a project to be economically feasible, the IRR must exceed the discount rate. The RBD rate of return of 10 percent exceeds the HUD-recommended project discount rate of 7.0 percent.

Figure 13 shows a breakdown of the benefits of the Long Beach WPCP Project.

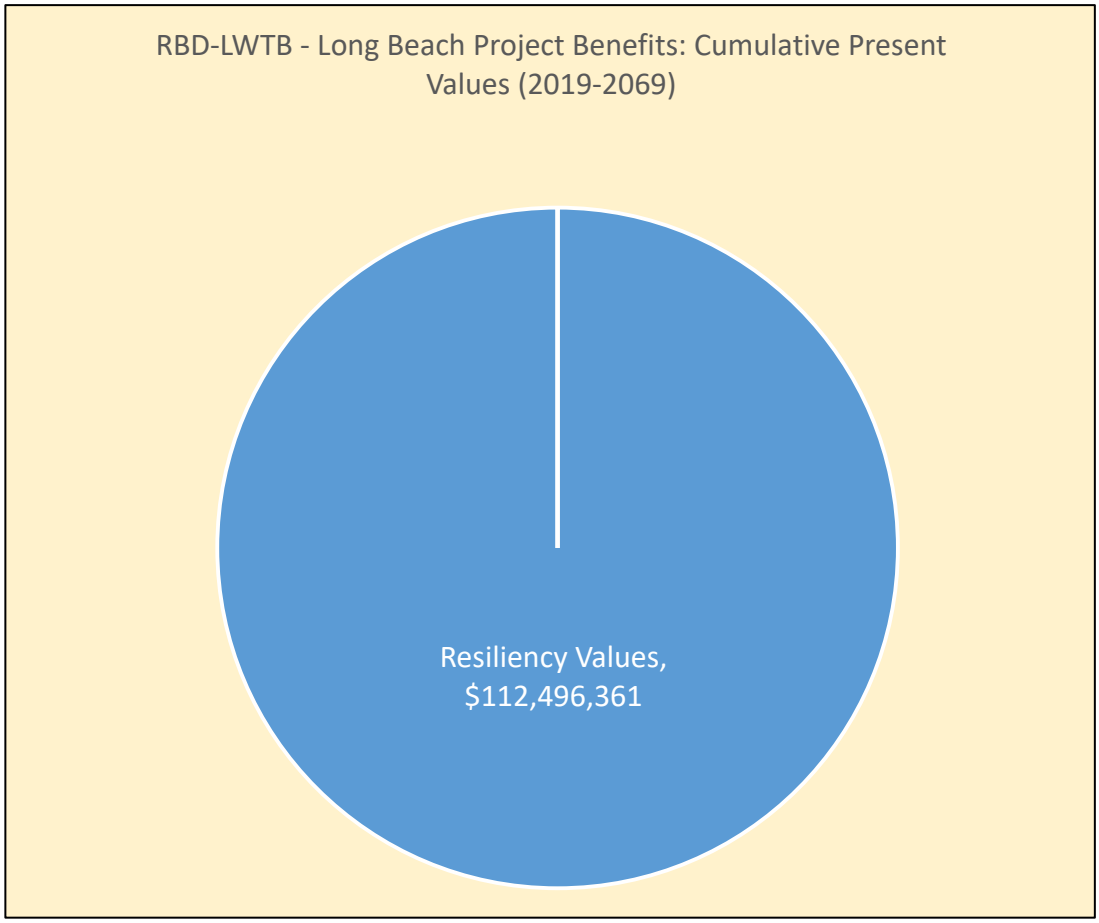


Figure 13: Breakdown of the Benefits of the Long Beach WPCP Project

8.0 PROJECT RISKS

8.1 Description of Project Risks

A large-scale watershed-based intervention such as the LWTB Project can be confronted with numerous risks. These risks run the gamut from increased costs for construction raw materials and labor to schedule delays, stakeholder and coordination issues, and potentially disruptive acts brought by disgruntled stakeholders who do not appreciate nor understand the goals of the project. These risks can also influence the proposed timing of the project interventions and schedule. With these short-term manageable risks comes the long-term uncertainly of climate change and the likelihood of more frequent and severe climatic events that can influence the Mill River Basin, greenway, and surface water bodies.

8.2 Sensitivity Analysis

A sensitivity analysis was completed that assessed the impacts of the Project's cumulative present value of net benefits and BCRs based on potential increases in lifecycle costs, reductions in anticipated benefits for the categories providing the most value, and construction delays. **Table 26** shows the results of the sensitivity analysis.

Table 26: Benefit Cost Analysis Sensitivity Analysis Living with the Bay Combined Projects

	Project Net Present Value	BCR	Difference with Net Present Value Baseline
Baseline	$211,512,835	2.44	$0
Increase in Capital Cost			
130% of Baseline	$170,327,570	1.90	-$41,185,265
Increase in O&M Cost			
150% of Baseline	$206,607,148	2.36	-$4,905,687
Decrease in Resiliency Benefits			
75% of Baseline	$172,576,956	2.17	-$38,935,879
50% of Baseline	$133,641,076	1.91	-$77,871,759
25% of Baseline	$94,705,196	1.64	-$116,807,639
Zero Resiliency Benefits	$55,769,317	1.38	-$155,743,518

A 30 percent increase in capital costs would the lower the BCR to 1.90 from 2.44 and lower the cumulative net present value of the project (net benefits) by $41 million. A 50 percent increase in annual O&M would result in the baseline BCR declining to 2.36 from 2.44.

Resiliency values represent the largest category of values (43 percent). The sensitivity analysis starts by reducing the combined value of resiliency benefits to a percentage of the baseline total value for this category. The project's total net present value would still be positive even if resiliency benefits fell by 75 percent, to a level representing 25 percent of the baseline total amount. The other value categories (Environmental, Social and Economic Revitalization) could sustain the positive BCR, if resiliency values were zero.

8.3 Assessment of Implementation Challenges

Implementing a large project in a densely populated area can present challenges during the various project stages: design, construction, and operations. During the construction phase, there are challenges likely to be encountered with area traffic management. In addition, there are logistical challenges associated with finding adequate space for laydown and staging areas to store equipment and materials in tight spaces in some areas along the Mill River within the project area.

There is also a risk that with some of the projects the demand for certain raw materials (sand, rocks) may drive prices higher than initially estimated. This heightened level of construction and development activity may present increased demands on scarce resources such as skilled labor and craft workers, select materials and equipment and contractors available for work on specific project elements and contract packages. These kinds of market demands can be reflected in higher costs for both labor and materials, and potentially result in scheduling delays.

Given the large number of public agencies, and other stakeholders (both public and private) involved in the project, there may be some challenges encountered related to coordination, communication and

scheduling/sequencing of events, and timing. These coordination issues are likely to arise during the design, construction/implementation and operational stages of the project.

9.0 CONCLUSION

Project Interventions to Meet LWTB Objectives: The BCA evaluates the following projects within the LWTB Project that address the goals and objectives of the LWTB Project. The interventions evaluated in this BCA include the following projects.

- HLSP
- Smith Pond
- ERHS
- Lister Park
- Long Beach WPCP Consolidation
- Greenway Project
- East and West Boulevards Project
- Educational Programs

BCA Economic Feasibility Results: The BCA demonstrates that the project would generate substantial net benefits (i.e., the benefits would exceed the costs of the project over its useful life). The benefits to the host community and region would be substantial and justify the costs of implementation and operations. The project assets would create large resiliency values, social values, environmental values, and economic revitalization benefits to communities within the Mill River Watershed and other beneficiaries from Nassau County and the region who use HLSP, Smith Pond, ERHS, the greenway and who recreate on Back Bay.

Table 27 shows the monetized costs and benefits for each project individually, and for the combined projects. The largest group of benefits consists of resiliency values related to flood risk protection provided by the Projects' assets. In summary, the combined lifecycle costs to build and operate the proposed Projects' assets for the LWTB resiliency Project (amounting to **$147.1 million** in constant 2018 present value dollars) would generate the following total benefits:

$358.6 million, of which:

- Resiliency Values: $155.7 million
- Environmental Values: $47.1 million
- Social Values: $34.3 million
- Economic Revitalization Benefits $121.5 million

Table 27: Benefit Cost Analysis Summary-RBD Living with the Bay

	HSLP b\	ERHS	Smith Pond	Greenway	Lister Park	Education	EW Blvds	LBWPCP	Total
LIFECYCLE COSTS									
Project Investment Costs a\	$33.3	$1.9	$8.2	$10.0	$2.2	$0.0	$3.5	$77.2	$137.3
Operations & Maintenance	$3.4	$0.8	$0.8	$3.3	$0.9	$1.0	$0.3	$0.3	$9.8
Total Costs	$36.7	$2.7	$9.0	$13.3	$3.0	$1.0	$3.8	$77.5	$147.1
BENEFITS									
Resiliency Values	$0.0	$1.0	$33.6	$2.6	$0.3	$0.0	$5.8	$112.5	$155.7
Environmental Values	$7.7	$2.3	$0.1	$31.0	$3.2	$1.3	$1.2	$0.0	$47.1
Social Values	$15.6	$0.0	$0.2	$18.5	$0.0	$0.0	$0.0	$0.0	$34.3
Economic Revitalization Benefits	$78.7	$0.0	$4.6	$38.2	$0.0	$0.0	$0.0	$0.0	$121.5
Total Benefits	$102.1	$3.4	$38.5	$90.3	$3.6	$1.3	$7.0	$112.5	$358.6
Benefits less Costs									
Net Benefits c\	$65.4	$0.7	$29.4	$77.0	$0.5	$0.3	$3.2	$35.0	$211.5
BCR	2.8	1.3	4.2	6.8	1.2	1.3	1.8	1.5	2.4
RBD Rate of Return	92.3%	9.7%	40.0%	165%	8.9%	9.2%	13.6%	10.2%	33.2%

Notes: Constant 2018 US Dollars - Discount Rate, 7%, Cumulative Present Values, 2019-2069

\a Costs represent the discounted present value of the nominal projected costs (over 2019-2069). Therefore, they will appear smaller than the nominal costs due to the application of the 7% HUD recommended discount rate.

\b HLSP resiliency benefits associated with the dam improvements, such as the improved management capabilities within the upstream catchment portion of the watershed are not reflected within the BCR but are acknowledged to be a significant benefit that would be assigned a + (i.e., expected positive impact) per HUD qualitative rating instructions. Water quality values for HLSP were included from wetlands creation within the Environmental Value section of the BCA.

\c Net Benefits are calculated as Total Benefits minus Total Costs.

Figure 14 shows the breakdown in total benefits for the combined four project elements.

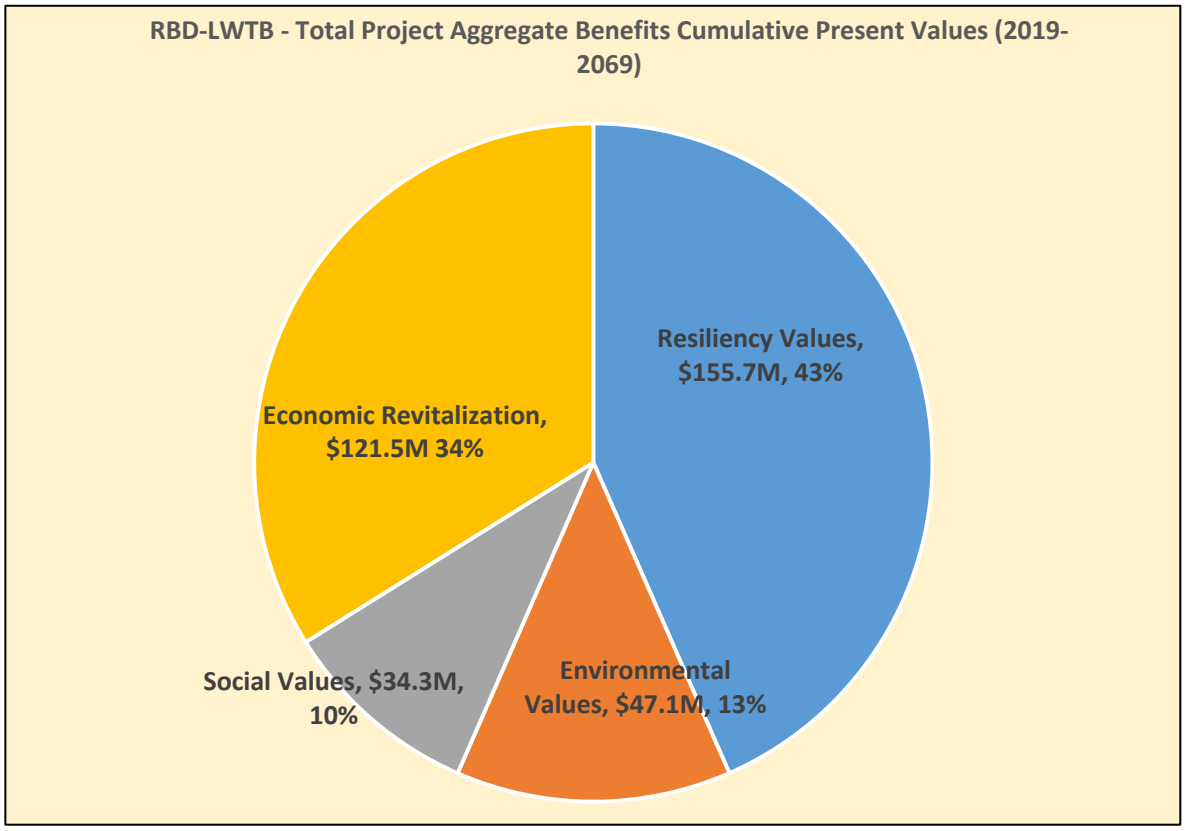


Figure 14: Total Benefits of Combined Project Elements

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